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EDITORIAL NOTES.

A Progressive and Economic Industry.

TOWARDS the end of last week, there were published the Board of Trade returns relating to company gas undertakings for 1911, and to local authority concerns for the year ending just twelve months since. The returns have put in a later appearance this year than last. Nearly fifteen months have, in fact, elapsed since we reviewed the immediate predecessors of the present issues—our notice of them having appeared in the "JOURNAL" for Jan. 9 last year. This occasion it is March 25; and we make a point of this, as it brings to mind the backward condition into which the returns fell in the matter of publication a few years ago—much to the disadvantage of those engaged in parliamentary work, and to the depreciation of general interest and value. Then there came a change; and we were able to compliment the responsible department for the new expedition displayed, which gave us the returns within a reasonable time (having regard to the compilation, calculations, and revision involved) after the expiration of the periods to which they refer. But there has been a lapse from the last time-standard; and it is hoped that the next returns will make an earlier appearance, as we should be sorry to see further retrograde movement, and the old unfortunate arrear in publication be re-established.

Having ventured upon this mild reproach for delay, we turn to the total figures presented by the returns; and, supplementing what is said here, further details will be found in an extended article elsewhere. The statistics give cause for continued gratification; for they show that the expansion of statutory gas enterprise in the country proceeds on all sides, and this expansion is accompanied by material and increasing prosperity, to which large contribution is made by the struggle to progressively reach the higher planes of manufacturing efficiency. The law of averages is not a good one by which to judge the highest standard of industrial efficiency, as the average sacrifices the best results in order to fill up the voids between the average and the low efficiencies in the working of some undertakings. But while the illustrative averages progress year by year, it is a guarantee that the higher levels of efficiency are being sought and worked for to a greater extent; and therefore every advancing average shows that industrial efficiency is more and more generally moving upwards.

We will deal first of all with the points which, to our mind, indicate best (as being more immune than any of the other figures from the outside and uncontrollable influences which cause fluctuating result) this rise in industrial efficiency. These points are the relation of gas production to coal consumption, and the sales of gas. The statistics tell us that the 822 statutory concerns included in the returns (excluding all non-statutory gas undertakings) carbonized during the twelve months 15,635,012 tons of coal, which is an increase of 237,229 tons on the preceding year. The quantity of gas produced was 205,616,026,000 cubic feet, or an increase of 6,882,672,000 cubic feet. The quantity of gas sold was 189,046,549,000 cubic feet, which shows that the gas business expanded during the year by 6,212,621,000 cubic feet, which increase is upwards of 1000 million cubic feet better than that of the previous twelve months. This is satisfactory, and speaks of improved efficiency in use and extending popularity for an increasing number of purposes. The higher efficiency of gas-consuming appliances notwithstanding, and the additional prepayment meter consumers connected, the average consumption of gas per consumer has maintained an equality with the preceding year.

As to the point regarding the higher level of manufacturing efficiency, the quantity of water gas made during the year was 24,684,612,000 cubic feet; and deducting this from the 205,616,026,000 cubic feet of gas made, we have remaining 180,931,414,000 cubic feet of coal gas, which, divided by the quantity of coal carbonized—15,635,012 tons—gives an average production per ton of coal of 11,572 cubic feet of gas. As an average, this is excellent, having regard to the past history of low gas production per ton all along the line of coals of varied quality; but the present average is not the end. Year by year, it rises to higher levels. In the year preceding, it was 11,383 cubic feet per ton, or an increase of 189 cubic feet; while, going back a further year, the average make was 11,160 cubic feet per ton, or 412 cubic feet less than for the year dealt with in the present returns. The rise in manufacturing efficiency represents large economy. If the average make of gas had remained on the scale of 11,383 cubic feet per ton, the tonnage of coal carbonized during the year would only have produced 177,973,341,596 cubic feet of gas, which would have been short by 2,958,072,404 cubic feet of the quantity of coal gas actually produced. To have provided this quantity, on the 11,383 cubic feet scale, would have meant that about 260,000 tons of coal would have been needed beyond the extra 237,229 tons used. The gains to the industry generally and undertakings in particular resulting from higher manufacturing efficiency are of a very material order, and strengthen substantially the industry's position and interests.

Further evidence as to the industry's prosperity and development is found in financial and miscellaneous figures. There was an increase of only thirteen in the number of statutory concerns embraced in the returns; but the capital authorized went up, by £1,851,829, to £159,192,876; while the amount actually paid up and borrowed advanced, by £1,414,233, to £136,097,928. The receipts for the twelve-months totalled to £32,318,770, which was an increase of £1,042,594. It was the year of great railway trouble and rising coal prices. These influences and increasing business caused an augmentation of expenditure; and the total outlay reached £24,065,305—being an increase of £853,926. Subtracting expenditure from receipts, we get a profit of £8,253,465, compared with £8,064,817 in the preceding year. Noticed among miscellaneous points are these: The number of consumers connected with the mains of the statutory undertakings rose, by 232,055, to 6,649,904; the length of mains increased, by 871 miles, to 36,993 miles; and the public lamps increased by 7763, to 728,548. This is a healthy condition of things; and, with such advance all along the lines of aggregate figures, it tends not only to increasing satisfaction, but to enhanced reputation.

The Findings in the Ilkeston Gasholder Inquiry.

IF the Ilkeston gasholder disaster and the official inquiry, with the focussing of the causes as far as has been possible in the report of Mr. A. G. Drury, M.Inst.C.E., result in a higher degree of critical supervision of gasholder design, and quality and strength of materials, in the case of a large number of gas-works, good will have issued from the lamentable occurrence. There are a few preliminary points that we wish to make before touching upon the main cause of the disaster as determined by the Inspector. In the first place, it is our duty to acknowledge the thorough manner in which Mr. Drury conducted his investigation, and the value of his report, the opportuneness of which cannot be questioned. In the second place, it is only right to point out that the Ilkeston accident and the Inspector's strictures regarding the want of adequate qualified supervision in this particular instance from the side of the purchasers of the holder, must not be taken by the members of other branches of engineering as supplying criteria to be applied generally to engineering qualification in the British gas industry; nor must it be allowed to lower in outside estimation the thoroughness with which, in at any rate the larger works, specification is made for such important structures as gasholders, and assurance given that design and the quality and strength

of all the members of the structure are complied with on the safe side. The extensive history of gasholder construction and working, and the large immunity from serious accident, support this, as well as the practices of gasholder contractors generally. In the third place, it is satisfactory to find Mr. Drury reporting that the inquiry completely establishes the fact that the spiral-guided type of gasholder is one that may be safely adopted, provided it is contained in a properly designed tank, and reasonable care and attention are given to the working and adjustment of the roller carriages in relation to the guides. In the fourth place, we are pleased to see that Mr. Drury does not (no engineer could do so) condemn overground steel tanks, provided they are properly designed, constructed, and maintained. But, as he says, in such structures nothing should be left to chance; and, in their design, adequate provision should be made not only for meeting ordinary working conditions, but all contingencies. In the fifth place, the report (including the appendices), in effect, if not in specific terms, exonerates Messrs. C. & W. Walker, the contractors for the holder, from blame in connection with the disaster. Mr. Drury himself says that he thinks the inquiry establishes the fact that the disaster is not to be attributed to any defect in the design or construction of the holder itself, nor, as a matter of fact, does he criticize the design of the tank, save by suggesting one or two improvements in detail. The criticism practically centres itself upon the quality of the fractured tank plates as disclosed by analyses; and in this matter of quality, Messrs. Walker appear to have been the victims of circumstances. The plate tests supplied to them by the rolling-mills show that they came, in the matter of phosphorus, within the British standard specification for steel, and, in regard to sulphur, the figures are practically the same as in the standard specification. But independent analyses of the fractured plates tell a different tale; and it is the phosphorus content to which is traceable the brittleness of the plates, and therefore the direct cause of the collapse, to the best belief of the Inspector. After this experience, contractors responsible for gasholder tanks, as well as the purchasers, will ensure that the results of the tests of the rolling-mills are certified by independent tests; and that the analyses made are fairly representative of the run of the plates.

It has been just as impossible for Mr. Drury, as for the other experts who have been engaged in this matter, to determine the exact manner in which the bursting of the tank happened. It is purely a matter of conjecture; but it seems to the Inspector, as it did to others, that something occurred to cause abnormal vertical stress through sudden shock upon the tank, which was somewhat light in construction, but, more important still, the plates of which (as already indicated) were not just of the quality that could be desired. Mr. Drury is, by deduction from the appearance presented by the fractured plates, inclined to believe that the bursting of the tank did not commence at the bottom or at the top edge as some of the experts thought, but at an intermediate point. He gives his reasons for this belief; and, if true, there is, in the finding, the evidence of plate weakness, and the confirmation that there was a brittleness at the place of fracture owing to the excess of phosphorus discovered by the subsequent analyses. The conclusion arrived at by Mr. Drury as to the fracture being due to the increase of vertical load brought to bear upon the tank by some abnormal and sudden happening, rather than by the steady horizontal pressure exerted by the water in the tank, bears upon that much-discussed point as to the factor of safety. In this tank it was below 4; and Mr. Drury in his recommendations suggests that it should not be less than 4. But this reminds us that, a few months ago, a consulting engineer called attention in our columns to the point that the stresses induced in the tank by the holder were, at the inquiry, practically ignored by the experts, with the exception of Mr. Doig Gibb. It is clear that no hard-and-fast factor of safety for steel tank construction should be adopted without considering fully the design of the holder, and whether it is intended that the same tank shall in the future accommodate an additional lift or lifts. Though mentioning "at least 4" as the factor of safety for tank construction, Mr. Drury does not overlook the vertical load, and stress contingencies due to abnormal circumstances, as those were, from his deductions, the only possible assignable causes in the chain of conditions that produced the final catastrophe. Furthermore, in the points which he recommends to the "serious consideration" of gas engineers and plant manufacturers, he suggests that, in all tanks for spiral-guided holders, an efficient pillar or strut should be introduced outside the tank, at each end of the load points, for the purpose of relieving the tank of *all* vertical pressure. This point is enlarged on, as are other matters which he submits for consideration. Therefore, in effect, what Mr. Drury recommends is that at least a factor of safety of 4 should be allowed (perhaps even a more generous factor in a spiral-guided holder tank than in a column-guided holder one, which in the main is only subjected to the static pressure of the water), *plus* the pillars or struts to relieve the sides of the tank of all vertical pressure.

Engineers and gasholder builders will find not only in the points specially recommended to their consideration, but also scattered through the report, several matters that are worthy of their attention, coming from (if not an expert gasholder designer) a competent critic of engineering constructional work. He marshals his reasons for believing that the two main factors in the wrecking of the holder were the extra vertical strain thrown upon the tank, combined with the quality or brittleness of the plates. As already mentioned, he points out the importance of systematic attention to the rollers and guides; for he is satisfied that sometimes there is considerable friction, and to such an extent that the bottom lift of the holder might be held up long enough to bring about the destruction of the water-seal in the lift above. Under such circumstances, there would be a sufficiently reasonable explanation as to how extra strain would be thrown upon the upper part of the tank side. Sudden liberation of the gas, too, might cause the weight of both lifts to be momentarily thrust upon the rail carriages on the edge of the tank; and this might be quite enough to bring about the failure of a tank constructed of brittle steel, the plates of which by former repeated applications of sudden load had been weakened. It is Mr. Drury's belief, too, that the gas was ignited by a spark produced by friction; and if this were capable of proof, it would supply a further link in the chain of circumstantial evidence as to friction having arisen, and a sudden extra vertical pressure having exerted itself on the tank. Another contributory point in the Inspector's opinion —and this will be a matter for the serious consideration of the designers of spiral-guided holders destined at some future period to be enlarged by the addition of an extra lift—is that the rail carriages projected out on the inside to the extent of 24 inches; and, in his judgment, the tank sides were especially weak to resist such a strain, and the plates below should have been aided by vertical stiffeners. The matter need not be carried further to indicate that it is the opinion of Mr. Drury that, if the material of the tank had been of proper quality, and had there been a little more strengthening in detail, nothing very serious would have happened from the sudden vertical pressure that was brought to bear upon the tank through some happening of probably quite a moderate and of a not uncommon nature in the working of a gasholder.

The point as to the quality of material used in structures with such responsibility upon them as gasholders is one of extreme importance; and Mr. Drury lays much stress, but not too much, upon it. He deprecates the use of basic Bessemer steel, and urges the adoption of the British standard specification for structural steel for bridges and general building construction. But the fact remains that practice varies as to whether in such structures steel is used made by the Bessemer or by the Siemens-Martin process. Engineers' views differ; but steel manufactured by the latter process has been strongly urged for specification by more than one authority on gasholder construction. At the same time, numerous examples of Bessemer steel gasholder construction are and have been long standing, and are giving every satisfaction. But all authorities will confirm Mr. Drury's recommendation that the steel should be to the British standard specification, and not only specified, but that steps should be taken to assure that there is adherence to the safe limits set by the specification. The discrepancies between the analyses forwarded to Messrs. Walker from the rolling-mills and those shown by independent tests—more especially in respect of the phosphorus in the parts of the plates near the fracture—emphasize the necessity of buyers, as well as contractors, taking steps to safeguard themselves. A comparison of the tables in the appendices bearing upon this point is both instructive and monitory. The figures disclose not only an excess of phosphorus but an unevenness of quality, and one can gauge from the data that the plates were brittle.

There are other matters dealt with in the report which, though general, are also important, and should result in care

in the future, and a revision of practice in many places. There is a little censure for the Ilkeston Corporation for having placed before the Local Government Board, when applying for a loan, plans showing a brick-and-puddle tank, and then departing from this to the over-ground steel tank, without submitting to the Board the alteration in the plans. There was justification for the change; but this does not relieve the Corporation from a certain amount of responsibility for applying for a loan for one form of construction, and then adopting another. The next point is of a somewhat more delicate nature. During the past decade or two the practice has grown largely on the part of a rather considerable proportion of medium-sized and small undertakings to enter into contracts for heavy engineering construction, without having the advice and the supervision of specially qualified engineers. But for the influences of competition, in special work there are really no more capable advisers than specialist contractors. Acknowledging this, however, does not relieve the purchasers from protecting themselves. And, as a matter of fact, such protection of the buyer relieves the contractors of part of the weight of responsibility. Mr. Drury strongly deprecates this neglect of skilled protection by one of the parties to a contract for any structure upon the reliability of which safety of life and property depends. We are not speaking here of works with fully trained engineers and competent staffs. We all know there are many skilled gas managers in this country who are competent in all gas matters save in taking sole and full responsibility for the construction of such a considerable piece of engineering work as a gasholder. They have not had the training for such work, nor the opportunities for obtaining the essential wide experience of it, as new gasholders are not of frequent necessity on moderate sized works. We hope, however, that Mr. Drury's remarks in this connection will not, outside the ranks of the gas engineers of this country, be taken as a universal reflection upon their engineering competence. This would be a mistake and unjustified.

Private Gas-Driven Electricity Generating Sets.

THE question of gas undertakings interesting themselves in the legitimate business of installing private gas-driven sets for the generation of electricity for the supply of large users of current for lighting or power or both, is one that is worth following up as being a good trading proposition. The paper by Mr. F. H. G. Goodwin, in the "JOURNAL" for March 4, had as one of its motives the urging upon gas undertakings in the industrial areas of the country to look well after this line of business in connection with factories. But those gas undertakings that have not taken in hand this class of work might be urged to follow it up in any and every quarter where there are large consumers of current; for the evidence grows that there is some excellent business to be done, and that there is mutual advantage in it for the gas suppliers and the considerable users of electric energy. It has for some years been recognized by electricians that this is so; and we have not the slightest doubt that many of them have secretly marvelled that a greater number of gas undertakings have not taken a more serious interest in the question. True, they do not want them to; but they must count it strange that many gas undertakings are so apathetic in the matter. We recall that several years have passed since Colonel Crompton told a meeting of electrical engineers not to treat lightly this matter of the competition of private gas-driven generating plants; for he at all events knew of one that was producing for its user electricity at a lower all-round price than that at which the central electricity station, with its distribution and other expenses, could supply. We have seen many gas-driven plants since those days, furnishing the lighting and power requirements of big establishments; and for the purpose a large amount of space is not required.

The matter crops up again in an article in the "Electrician," on "Electric Theatre Installations," by Mr. S. Burns. In this, the writer considers the question of whether, in place of the local electricity supply, a small motor generator or an engine-driven set can be profitably installed; and, if the latter, whether the fuel should be gas or oil. He comes to the conclusion that the installing of an engine set may be looked upon as more economical than a motor generator set scheme, in that it ensures a comparatively low cost per unit. It is palpable that the writer of the article prefers the clean, reliable, on-tap town-gas supply, though he considers oil and producer gas. But these entail costs in space, storage, and provision of fuel that are entirely absent with the town-gas driven plant. Mr. Burns mentions one case in which with gas at 2s. 1d. per 1000 cubic feet, and allowing for all attendance, renewals, depreciation, and interest on capital charges, the cost per unit worked out at 1½d. Then he gives comparisons, on suppositious cases, with the cost of taking energy from a 220-volt direct current supply at 3d. per unit. It is assumed by him that 70 amperes at 65 volts represents the current requirements of a bioscope running 130 hours per month. This would mean that the running cost per month, with resistances, would be £29. He takes an engine, working on town gas, at 2s. 6d. per 1000 cubic feet. This with a belt-driven generator and generator switch gear, has a prime cost of £116. Taking 10 per cent. per annum for depreciation on the gas-engine, and setting aside 6s. 8d. per month for renewals, &c., and assuming the high figure of 20 cubic feet of gas per brake horse power hour, the monthly saving, he calculates, would be £24 15s. So that the prime cost of the installation would be worked off in nineteen weeks. Mr. Burns also considers the matter in relation to a direct-coupled gas-engine set. The prime cost is higher than for a belt-driven one, and, with depreciation and renewal charges as before, the monthly saving is £24 8s., so that 25 weeks' running would wipe out the cost. That is sufficient. We will not go into the question of oil, as there is no advantage in the matter of saving; and the trouble to the user is much greater.

Mr. Burns, however, is evidently an authority on these matters; and there is confirmation in his article that, even for such small sets as are required for the work of running a "picture palace," there is a saving upon the low charge of 3d. per unit for a supply from the local electricity mains, and that the saving is of such a character that the whole first cost of the plant can be wiped out by it in a very short time. Not only is this the case with small generating sets, but it is the same with large ones. In one part of London not long since a fine generating set (in duplicate) was seen that was, and is, rendering service for lighting only at a price much below the lowest quotation that could be obtained from the local suppliers. There are several installations of plant in London. We have spoken before of what the Tottenham and Edmonton Gas Company are doing in this line at Wood Green, the district for which they are applying in the present session of Parliament for powers to furnish a general supply of current by gas-driven plant. The North Metropolitan Electric Company are opposing the Gas Company's scheme; but the scheme of the latter has great local favour. One of their supporters is a Mr. A. C. Denham, whose firm runs a large gas-driven generating set of their own; and a couple of passages in a letter he has contributed to a local paper are eloquent as to his views. He writes: "Your readers will "grant me and my firm enough foresight to have made our "position perfectly secure before we put down the finest "private generating-station in London, involving an outlay "of £7000. Having some experience of the generation of "electric current by gas, I believe the Gas Company's "scheme is the better of the two." Small plants or large plants, the testimony is the same. Private gas enterprise has to meet the competition of municipally-run electricity supply systems, and energy supplied for power at a penny and fractions of a penny per unit. If gas undertakings can furnish the means for large users or comparatively large users of electric energy obtaining it at an economical rate, they will be doing a public service, and at the same time benefit themselves.

London Gas Companies' Working Last Year.

IN another part of the "JOURNAL" will be found a table giving the financial results of the working of the three London Gas Companies in the year ended the 31st of December last, with the items of revenue and expenditure worked out at per 1000 cubic feet of gas sold. For the sake of comparison, similar particulars for the two preceding years are given. It will probably be remembered that, by the courtesy of Mr. F. J. Bradfield, the Secretary of the Commercial Gas Company, we were able to give on Aug. 13 and Feb. 18 last the analyses he had prepared (in continuation of previous similar compilations) of the half-yearly accounts of the three London and four of the Suburban Gas Companies for the year 1912, together with, in each case, a table showing the increases or decreases which had taken place as compared with the corresponding half of 1911. In

these tables, the accounts were dealt with in such detail as to render unnecessary, as pointed out last year, the analysis which for some considerable time appeared in our pages. It was thought, however, that it might be useful to present the capital raised and the totals of the various items of revenue and expenditure of the three principal Companies. It will be seen that the capital (including premiums) engaged in the supply of gas on Dec. 31 amounted to £40,560,260, that the total income was £7,721,069, the expenditure £5,977,217, and the gross profit £1,743,852. The gross profit was £4 6s. per cent. on the capital and borrowed money, and £34 6s. 3d. on the total gas-rental. On the basis of each 1000 cubic feet of gas sold, the figures are: Capital, 18s. 7·78d.; income, 3s. 6·6d.; expenditure, 2s. 8·98d.; profit, 9·62d.

The following table shows the carbonizing results of the three Companies, so far as they relate to the manufacture of gas from solid raw material only; and a noteworthy feature is the further increase in the quantity of gas produced in the case of each Company. The mean make per ton last year was 12,373 cubic feet, as compared with 12,047 and 11,828 cubic feet in the two preceding years.

TABLE *showing the Residual Products and the Gas Made per Ton of Coal by the Metropolitan Gas Companies in the Year* 1912.

Name of Company.	Coke.	Breeze.	Tar.	Am. Liq.	Gas.
	Cwt.	Bushels.	Gallons.	Gallons.	Cub. Ft.
GASLIGHT AND COKE .	12·63	4·82	9·62	36·89	12,305
SOUTH METROPOLITAN .	12·33	4·14	9·58	40·50	12,386
COMMERCIAL	12·50	4·58	13·03	37·00	13,030
Mean per Ton . .	12·52	4·57	9·80	38 16	12,373

High-Pressure Gas Practice.

That high-pressure gas distribution and application have become a big and an important factor in the industry's commercial life, is evidenced by the paper that Mr. N. B. Hodgkin read last Saturday week before the Midland Junior Gas Association. The paper, as the portions we have published have shown, was an extensive one; and it might well, as was suggested during the discussion on it, have been split up into at least three valuable contributions. However, there is no question of Mr. Hodgkin being thorough in whatever he takes in hand; and his paper will be found extremely useful to those who are entering upon high-pressure work. It is a difficult paper to say merely a little about, inasmuch as it is constituted of a hundred-and-one practical points from main and service laying for high-pressure gas transmission to the points of use for lighting and industrial purposes Readers of the paper will not positively agree with the author on all matters, any more than did some of those who took part in the discussion upon it at the meeting. Experiences vary, and local conditions frequently produce the variation. As experiences vary, so do practices. But high-pressure work has now reached a point where notes can be profitably compared. At the advent of high-pressure distribution and supply, practices were of a somewhat crude character. It is generally so with all new departures, until experience and investigation point out the ameliorating and improving steps that should be taken. The same difficulties have presented themselves where circumstances have been alike, but the means of overcoming them may have differed. Hence the value of contrasting notes.

A Central Laboratory.

Mr. Hodgkin wishes that the gas industry possessed a laboratory to which reference could be made by any undertaking. This is a wish that was expressed long years since, just as was that for an experimental gas-works. The need is emphasized by the fact that the very best of everything is now required in connection with all applications not only of high-pressure gas, but of low-pressure gas. But there is a difficulty about a central laboratory undertaking universal work, and especially so in connection with applications of an industrial character. Birmingham has its own high-pressure gas laboratory; Glasgow is going to have its high-pressure laboratory. The industries of Birmingham and of Glasgow are largely dissimilar; and no central laboratory could do for Birmingham and Glasgow what a laboratory in each city can do. The central laboratory would be out of touch with conditions and requirements. We do not say that a central laboratory would not find much work of a highly useful character to engage its attention; but we do not think it could altogether take the place efficiently of the local laboratory. Talking of testing, there is full agreement with the author's and Mr. E. W. Smith's point as to the necessity for lamp manufacturers stating fully the conditions under which are obtained the efficiencies claimed for their productions. If calorific power, pressure, and specific gravity of the gas were stated, one might then be able to track out the cause, under other local conditions, of variations from the makers' efficiencies. It is interesting to learn from Mr. Smith that, in Birmingham, it has been determined that a pressure of 100 inches is the best for realizing the highest efficiencies in high-pressure lighting, taken in conjunction with the life of the mantles.

Returning Evil for Good.

In an earlier column, we make some further reference to the subject of private gas-driven electricity generating sets, and to their economy to the user of current. The Lewisham Board of Guardians and the ratepayers have reason to be grateful to the South Metropolitan Gas Company for showing them that, by a private gas-driven plant, they could obtain for the workhouse and infirmary energy at a lower rate than the South Metropolitan Electric Light and Power Company were offering to supply at. The latter Company offered to supply first at 3½d. and then at 3d. per unit, while the Gas Company guaranteed that, by a gas-driven plant, the Guardians should have energy at 2d. per unit for lighting and 1½d. for power, including all costs; and the guaranteed figure was not the rock-bed one. Apparently, this came quite as a shock to the South Metropolitan Electric Power Company, for they rapidly slipped down to the prices named by the Gas Company. Either, at 3d. per unit for lighting, they were proposing to take more from the ratepayers than they were justly entitled to, or else the prices quoted by the Gas Company are not profitable to the Electricity Company. Which is it? The Guardians in Committee have decided, by a small majority, to accept the revised tender of the Electric Company. But the matter is not determined yet; for it is to come up again for consideration at the next ordinary meeting of the Board, when some pertinent questions may be asked. If the decision is finally against the Gas Company, it will be unfair. It was their scheme that gave the Guardians the lowest cost for electrical energy; and yet the Electric Power Company, by amending their offer on the guaranteed lines of the Gas Company, are, it seems, to be favoured with the business. If this is the upshot of the matter, the Gas Company must content themselves with such satisfaction as is to be obtained from having done the ratepayers a good turn. But if the incident had not given them an advertisement as to their capacity in this matter of cheaply generating current, the "reward" meted out to them so far by the Guardians would have been still more unjust.

Coke-Oven Managers and Gas Organizations.

Regarding the suggestion made in our columns on March 4 (p. 606) by "Coke-Oven Manager," that the technical organizations of the gas industry should open their doors to coke-oven managers, it will be remembered that some editorial comments on the subject appeared in the succeeding issue. These comments have brought from another correspondent interested in coke-ovens a communication, which shows that he is not in agreement with the view that the acceptance of the proposal by the gas organizations would meet with very hearty response from those technically concerned in the management of such plants—not because they personally would not be pleased to unite themselves with the gas engineers for their mutual edification, but for a totally different reason. He does not, though intimately acquainted with the coke-oven industry, detect any keen movement in taking up the idea; and the cause of this he thinks is that the plants are all privately controlled, and that the managers have not a free hand. "I, myself," he adds, "would very much like to enter the 'charmed circle,' but at present must 'wait and see.'"

Kent Coal for Gas Making.

Allusion was recently made in these columns to the fact that the Dover Gas Company had arranged to test the value for gas making of coal from one of the Kentish collieries. It requires no stretch of the imagination to arrive at the conclusion that—if

the price of local coal were substantially lower delivered on to the gas-works in the south-eastern part of the country, although the gas-yield per ton was not so high (say) as from Durham or Yorkshire coal, but providing coke and other residuals were of good quality—the profit per ton of coal carbonized might make the transfer of coal purchases to the local collieries a matter of good policy. The prospect of something of the kind coming about is not so hazy now as it has been for years past. The test has been made at the Dover Gas-Works by Mr. W. R. Herring, the Company's Consulting Engineer, and his brother (Mr. E. C. Herring), the Resident Engineer; and it has been conducted in a manner to give full information as to gas, coke, and the other residuals. We do not think that, at this stage, we shall be committing any breach of confidence in saying that Mr. W. R. Herring looks upon the coal proposition in the East of Kent as quite a serious commercial one, and one that must inevitably exercise considerable influence on the industrial developments of the area within reach of the collieries. Its influence, however, on Greater London depends primarily on the action of the Railway Company in whose hands rests to a large extent the financial destiny of the collieries. It will be mainly a question of railway rates *versus* shipping freights. We are hoping that in due season Mr. Herring will be in a position to publish in our columns further information concerning this interesting development, which now appears (though one hesitates to speak more definitely yet) to possess about it something of a more tangible nature than it has had ever since the most brilliant and fascinating prospects were first circulated far and wide by the pioneer exploiters. If this tangibility grows "more so," then a new era will open for industry in the south-eastern part of our country.

Parsimony of Some Local Authorities.

There is one criticism in the report of Mr. A. G. Drury to the Home Office on the Ilkeston gasholder disaster, that is of a character that induces special reference for the purpose of giving emphasis apart from any other considerations arising out of the report. Mr. Drury, as Engineering Inspector of the Local Government Board, has experience of the methods of local authorities; and therefore what he has to say in this connection cannot be ascribed to any mere superficial observation. He animadverts on the mistaken ideas of economy on the part of some authorities when carrying out new works. It is too often the case, he remarks, that, labouring under the mistaken notion, they elect to dispense with the services of a qualified adviser. They do this not only because they grudge his fee, but they fear that, as a result of such action, they might be compelled, against their inclinations, to adopt more substantial and costly works. "There is little room for doubt that, in the long run, and in the interests of all concerned, it is the best and cheapest policy; and it has been amply exemplified in the present instance." The words of the Inspector call for no comment.

Self-Lighting Gas-Mantles.

The following remarks appeared in the "Daily Telegraph" a few days ago under the head of "Technical Topics:" "An indication of the good results of competition between gas and electricity is afforded in the most recent development of the incandescent gas-mantle, which is now being arranged to light-up without the need for applying a match in the ordinary way. This is effected by the admixture with the thorium compound composing the mantle, of a substance such as lithium chloride, which, like finely-divided platinum, becomes heated when played upon by a stream of coal gas, so that the latter is ignited. At present inventors are finding some difficulty in selecting an igniting material which will retain its properties indefinitely; but when this difficulty is overcome, gas will be even with electricity on the score of ease of lighting."

Marriage of Mr. W. M. Mason.—At the Presbyterian Church, Regent Square, Gray's Inn Road, W.C., last Thursday, the marriage was solemnized of Mr. W. Matthew Mason, the Secretary of the British Commercial Gas Association, and Miss Grace Davidson Walker, daughter of Mr. and Mrs. T. P. Walker, of Cambridge.

Informal Meeting of Scottish Gas Managers.—We learn from Mr. J. W. Napier, of Alloa, the Convener, that the thirtieth annual informal meeting of Scottish gas managers will be held in the Grand Hotel, Glasgow, on Wednesday, the 2nd prox. The President (Mr. Samuel Milne, of Aberdeen) will occupy the chair. At the close of the proceedings, those present will, as usual, dine together. The Convener hopes there will be a large attendance.

THE CHAIRMANSHIP OF THE IMPERIAL CONTINENTAL GAS ASSOCIATION.

Resignation of Mr. J. Horsley Palmer.—The New Chairman.

THE announcement reaches us that Mr. J. Horsley Palmer has been compelled, on account of continued ill-health, to resign the position of Chairman of the Imperial Continental Gas Association, and that Sir Charles Jessel, Bart., has been elected by his colleagues to fill the vacancy. Mr. Palmer was absent from his accustomed place at the British Gaslight Company's meeting on Wednesday last; and Sir Corbet Woodall, who, in consequence, undertook the duties of the chair, referred, with the deepest regret, to the cause of the absence of the Chairman. All identified with the Imperial Continental Gas Association, and many outside the Association who know the genuine worth of Mr. Palmer, will join in the sorrow of his directorial colleagues that he, after ten years' service as Chairman, has been obliged to relinquish the office, though, we hope events will happily prove, not a place as an ordinary member of the Board (with which he has been connected now for some 38 years). The chairmanship of the Association, with its extensive public service and obligations on the Continent, confers on the occupant a distinction of high order among gas administrators; for no one would be selected for the position, which demands so many personal qualifications, unless he had given proof to his colleagues of special diplomatic and other fitness for it. But now for some time past Mr. Palmer's health has been very indifferent; and a couple of months ago he found it necessary to leave England for a stay at Teneriffe in the hope that there would be recuperation from rest and change of air. Unfortunately, this hope has not been realized; and Mr. Palmer's medical advisers have now enjoined upon him an absolute abstention from business for some months to come. His colleagues sincerely hope the real rest he is obliged to take will enable him later on to resume his duties on the Board.

As Chairman of an Association operating in several Continental cities, and having to deal with many authorities, with an army of officers and workmen, and with diversified and widely separated commercial and other conditions, Mr. Palmer was a strong man. He looked his part, and did his part, and always with an innate geniality that did much to enable his administrative strength to carry him far. The officers and men—we can speak from personal knowledge—highly esteem him, recognizing in him at once a leader and a friend. He always was, and we know always will be so long as he can voice his views, the first to defend the fullest policy of the Board in looking after the present and future welfare of the officers and men. It has never been too much for him (health permitting) to travel to the Continent in all weathers to be present at their functions on such occasions as anniversaries or other celebrations, and to show his personal interest and concern in their affairs—in fact, their interests were his interests. He made it his business to know the officers by direct contact with them. At the London office, too, though Chairman, Mr. Palmer's frequent attendance, and his interest in the work, with its multifarious detail, that has to be transacted there, made him a *persona grata*. With the Secretary (Mr. Robert W. Wilson) and his assistants, he has been in effect—we know it well from observation—as much the friend and colleague as the Chairman. In short, between him and them there has been no gulf; for he recognized that his interests as Chairman (though greater his responsibility) and theirs as executive officers were mutual in every degree. Taking a broader view, we should like to add that Mr. Palmer over a long course of years has never turned a deaf ear to the claims of any movement that showed itself to be good in the common interests of the gas industry; and whenever there have been organized visits of professional gas men from the Continent to this country, he has been there to greet the guests, and assist in showing them hospitality. A man of many parts, we hope to see him restored to health, so that for years to come that ripe, broad, and robust statesmanship of his may be employed to the advantage of the Association, and of the gas industry generally. We are glad to have this opportunity, though regretting the cause that supplies it, of writing this appreciation of one who has rendered distinguished administrative service.

Sir Charles Jessel, the new Chairman of the Board, has been a Director since 1895. He is a son-in-law of the late Right Hon. Sir Julian Goldsmid, Bart., M.P., who for many years was Chairman of the Board of the Association. Mr. Arthur Lucas, who has been a member of the Board for nearly 35 years, and has occupied the post of Deputy-Chairman since May, 1903, will continue to act in that capacity—his other engagements not permitting him to accept the responsibilities of the chair. Speaking of Mr. Lucas reminds us that last May, he, as Deputy-Chairman, moved the re-election to his seat at the Board of Mr. Horsley Palmer; and the happy phrases he then employed come to mind as we write. Mr. Lucas observed that "there was an interesting fact regarding Mr. Palmer's connection with the Association which, he thought, was almost unique—certainly unique in the history of any gas company of which he (Mr. Lucas) knew. Mr. Palmer was the third of his generation who had occupied a seat on the Board. His grandfather was, as he understood, the Chairman, his father was a Director, and now Mr. Palmer had been a Director for 37 years, of which period he had now been Chairman some years. These were interesting facts; and there was no getting over the impression he felt that Mr. Palmer was saturated

with the traditions of the Association; and those traditions were exceedingly good, as the proprietors knew from the continued prosperity they had enjoyed for so many years. The history of the past guaranteed the future, so that the proprietors were perfectly safe in re-electing Mr. Palmer to the post which he had so ably occupied for many years."

PERSONAL.

Mr. E. D. Sapey, the Manager and Secretary of the Horsham Gas Company, has been again returned—this time unopposed—as a member of the Town Council, for a period of three years.

The Directors of the Wakefield Gas Company have filled the vacancy on the Board, caused by the death of Mr. W. H. Hughes, by unanimously electing Mr. Harry Townsend, M.Inst.C.E., as Managing-Director. Mr. Townsend has been Engineer and Manager of the Company for the past eighteen years.

Mr. John Kane, Assistant Gas Engineer and General Foreman at Dumfries, has been appointed to the position of Works Superintendent at Cheltenham. He served his apprenticeship with Sir William Arrol and Co., Limited, and was afterwards for nine years at the Dundee Gas-Works. He has been some three years at Dumfries, where the works have been undergoing a general reconstruction, and an installation of electrical stoking machinery has been made.

Mr. William Taylor, J.P., who has been for 45 years Manager of the Forres Gaslight Company, is about to resign his position on account of advancing years, but is to be still associated with the Company as a Director. He has agreed to act as the Manager until his successor can take up his duties. The Directors recorded their great appreciation of the valuable work done by Mr. Taylor, and their satisfaction that he would be still with them as a Director. Mr. W. M. Williamson has been appointed as Mr. Taylor's successor. He has been Manager of the Penicuik Gas-Works for two years, and was formerly Manager of the Oban Gas-Works, where he made considerable improvements. Previous to that, he was for ten years with the Leven Gas Company.

Mr. Samuel B. Chandler, eldest son of Mr. Samuel Chandler, has been appointed by the Directors of the South Suburban Gas Company to an important position in the Distribution Department. The satisfaction of his many friends in the London and Southern District Junior Gas Association (of the Council of which he is a member) at his good fortune will be all the greater from the fact that the change will not remove him from their district. Mr. Chandler, who entered the service of the South Metropolitan Gas Company (in which he now is) in 1907, under Mr. A. Stokes, received his education at the City of London School, and afterwards spent two-and-a-half years with Messrs. S. Chandler and Sons on gas apparatus work. He is the holder of ordinary and honours Gas Examination certificates. He will take up his new appointment at the end of this month.

OBITUARY.

LUDWIG DELBRÜCK.

The Imperial Continental Gas Association have lost a representative of rare ability, energy, and uprightness by the death, on the 12th inst., at the early age of fifty-three, of Mr. Ludwig Delbrück, who took charge of the Association's interests in Prussia. In all the intricate and often delicate negotiations which he had to carry through on their behalf, his unfailing tact and far-sighted business views always stood the Association in good stead; and his sudden removal, as the result of an apoplectic seizure, is a loss which the important undertaking he so ably represented will feel most acutely. On several occasions, in recent years, reference has been made to Mr. Delbrück's services by Mr. Horsley Palmer, the Chairman of the Association. On the transfer of the Frankfort works to the Frankfort Gas Company, in which the Association had a very large interest, Mr. Delbrück was elected a member of the Board; and Mr. Palmer said that so long as the business was in the hands of this gentleman, he did not think any great risk had been run in respect of the investment. At the meeting in November last, the Chairman, referring to the loss of the Aix-la-Chapelle station, said this had occurred notwithstanding the efforts of their "good friend and representative on the Continent, Mr. Delbrück." At the corresponding meeting two years previously, he was present, and Mr. Palmer expressed his pleasure at seeing among them one who "was devoted to the interests of the Association, and did his very utmost to advance them in Germany." These remarks were most cordially received. Mr. Delbrück succeeded his father, the late Mr. Adelbert Delbrück, as the Association's representative in Prussia in the year 1890, and consequently had acted in this capacity for a period of twenty-three years. In addition to the Association, Mr. Delbrück represented a number of other important concerns.

Deep sympathy will be felt with Mr. W. J. Carpenter, the Engineer, General Manager, and Secretary of the Great Yarmouth Gas Company, in the loss which he has sustained through the death of his wife on the 13th inst.

ELECTRICITY SUPPLY MEMORANDA.

On more than one occasion, we have been told by electrical people who pride themselves on their knowledge of the technic of the gas business, that the gas industry has reached its maximum of efficiency in all directions, and that the only thing to be done by it now is to make the most of the time before the total eclipse comes. At present, light for light, quality for quality, and price for price, we can beat the electrical industry easily with high and low pressure inverted lamps; and excellent authority tells us that, at any rate in the line of metallic filaments, there is not much chance of improving upon the efficiency already attained. The very best that can be done is with a special kind of lamp that has been evolved for projection purposes. This is not a lamp for ordinary use. In it the tungsten wire is rolled into the form of tape; and light is radiated from this at the rate of 1·65 candles per square millimetre of surface at an efficiency of 0·75 watt-hour per candle. Mr. Alexander Siemens, in a paper read before the Institute of Metals, states that such results as these, taken together with the high temperature at which the tungsten lamp works, make it very doubtful whether it will be possible to construct a still more economical metallic filament lamp, and that the consumer will have to look henceforth to improvements in the generation of energy for a reduction of the cost of electrical illumination. The physical obstacles to higher lamp efficiency, and so—at any rate, along that line—to reduced cost of illumination, bear upon the prospects of reaching lower prices in the cost of producing the lamps themselves. There does not seem to be much chance of this. A metallic filament lamp goes through eighty stages in the course of its production; and some of these stages are of a very delicate nature. Eighty stages cost money.

Metallics.

Light for One Shilling.

We have been interested in a graphic advertisement issued by the British Thomson-Houston Company, to illustrate what vast progress has been made in lowering the cost of electric lighting through the combined influences of the progress in electric lamp invention, and in price reduction for the current. A series of lamps illustrates the progress, beginning with the carbon lamp of 1885 and ending with the drawn-wire tungsten of 1912. It is represented that with the carbon filament lamp of 1885 200 candle-hours were obtained for 1s.—this being the price taken as the charge per unit; while with the lamp of 1912, and current at 4d. per unit, 2400 candle-hours are obtained for 1s. This shows that the reduction of the price of current to 4d. (where it is at 4d.) is responsible for at least two-thirds of the improvement in illuminating value gained for an expenditure of 1s. by the consumer. Had the price of energy still been at 1s. per unit, the comparison would then have been 200 candle-hours for 1885 and 800 candle-hours for 1912. If the householder who receives a postcard bearing on the back this representation of progress overlooks the "rate per unit" line, he may run away with the notion that the lamps are alone responsible for the difference between the 200 and the 2400 candle-hours realizable for 1s. In the gas industry, we have also made wonderful progress. Take a town where in 1885 the price per 1000 cubic feet of gas was 3s. 6d., and in 1912 2s. 6d. In that place, it was possible in 1885 to get with good flat-flame burners 720 candle-hours for 1s.; in 1912, with inverted incandescent lamps, 8000 candle-hours, or, with high-pressure gas and lamps, 24,000 candle-hours.

Foreign Productions.

There is more litigation coming along in connection with the decision of the owners of the Osram tungsten lamp patents to uphold their rights, and to defend the companies who are allied to them, and from whom royalty is drawn. But the Osram Lamp Works, Limited, have undertaken a big task. There was a case before the Courts recently in which some lamps imported from Belgium were concerned, and an injunction was granted. Another case was also mentioned a few days earlier; and more will be heard of it later on. The trouble to be contended with is that so many lamps that are considered to be infringements of the Osram patents are made on the Continent, and are then imported into this country, and scattered among the retailers. It is a difficult thing tracking these lamps, and some of them are very cheap and very nasty, and a long way, on the wrong side, from 1·25 watt-hours per candle power. The gas industry knows something about rubbishy stuff from abroad, but all that comes from abroad does not come into that category.

A False Decimal Point.

The electricity supply industry have their troubles over meter readings—more in proportion than the gas industry, owing to the unreliability of the mechanical arbitrators. As a rule, the electricity concerns try to compose consumers' differences of opinion with their meters. But a case has lately been heard before Mr. Justice Bankes in which no less a sum than £1880 was involved, for electricity supplied over three-and-a-half years ending on November, 1911. We do not remember anything that has reached the Courts quite so big as this in

the gas industry in the way of a gas account dispute; and Parliament takes good care that a gas undertaking shall not have the right to claim for such a period of time if it allows a faulty meter to continue. In the case of a defective gas-meter being discovered, it is taken that the fault arose in the then preceding quarter, unless it can be proved to have arisen in the current quarter. The same applies to the electricity industry; but the case before us, the plaintiffs held, is somewhat different. It is not represented that the meter was defective, except that the dial owing to the markings was so illegible that a whole figure could be read as a decimal. It was read as a decimal for three-and-a-half years, and resulted in the consumer being charged for only one-tenth of the proper amount—that is to say, the consumption had been 334,272 units, while only 33,428 units had been charged for at 1½d. per unit. Roughly speaking, the firm concerned (Messrs. Salomon and Co., of Old Kent Road) were only charged by the County of London Electric Supply Company £60 a year for power, while the charge should have been £600. The firm were contented; and no doubt would have been pleased to give a testimonial as to the economy of the electric-drive. The happy conditions for the firm were abruptly disturbed in 1911, by a meter reader correctly interpreting the indications of the meter. Then trouble arose, culminating in litigation. It seems that the motor the firm now uses is a 25-horse power one. It is an interesting case because the plaintiffs contend that the meter was not defective; that the trouble arose solely on a misreading; and that as the firm had the energy, and profited thereby, they ought to pay—though late in the day. As the error was continued by a servant of the supplying company for three-and-a-half years, it looked like a case in which the difference between the accounts rendered and the accounts that should have been rendered, ought to be one for compromise. As a matter of fact that is what has happened, only the supply company have got much the best part in the settlement. In the arrangement arrived at, they abated their claim by £150; and judgment was entered for them for £1730, and costs. The mark that was masquerading as a decimal point ought to be ashamed of itself causing this worry and expense.

Why Go to Liverpool?

It is a long time since we have seen our little friend "Electricity;" and it may be supposed that we should not have done so now, had not "Elektron"—the writer of "Current Topics" in it—felt some little pride in a comment of his on a paragraph that recently appeared in the "JOURNAL" (*ante*, p. 373) regarding the vagaries of the electric street lamps at Newquay. The modest paragraph is described as a "diatribe," which is much too grandiloquent an expression for the passing remarks that were made. Then the worthy "Elektron" proceeds: "I venture to suggest that gas for street lighting is not altogether so infallible as my contemporary would appear to infer. Let him visit Liverpool, or any other gas-lit town, some time during the present month for example, when the gentle zephyrs of coming spring are having full play; and I warrant he will find nearly as many extinguished jets and broken mantles as light-giving ones; and this in spite of a thoroughly organized daily inspection and replacement system." Does "Elektron" live in London? If so, why trouble to go to Liverpool to see what "gentle" zephyrs—such as those we had during the past week—can do when in "full play."

Hire-Purchase.

If it is not one thing it is another that stops the advance of the electric-cooker into full possession of the immense field which is believed to be its very own "land of promise." According to Mr. Julian G. Thain, the Engineer of the Stratford-on-Avon Electricity Department, all that is now wanted is the introduction of the system of hire-purchase. But the difficulty is to know who is to take it up and run the risks with a piece of apparatus that shows a marked propensity for doing those things which it ought not to do. A few municipal electricity supply undertakings have risked a hundred or two of their profits in hiring-out; but there are many electrical engineers—Mr. Thain among the number—who think that the makers of electric-cookers should take upon themselves the responsibility of introducing and running hire-purchase. Electrical engineers are rather good at counselling electrical manufacturers as to what they should do. We do not see any substantial argument in support of manufacturers having this business foisted on them. The object of the cooker, from the electricity supply undertakings' point of view, is to afford a channel for building-up an account for energy; and therefore it seems to us that it is not the business of the manufacturer to make provision for hire and hire-purchase. If manufacturers, says Mr. Thain, were to "hire-purchase out electric-cookers, I, for one, would be able in a comparatively short period to increase my day load peak by at least 40 per cent." But when electric-cooker lives are short, and the cost of production is high, the maker cannot see much lucrative business for him in the cookers—unless he can sell outright. He has only to look at the tail-end of Mr. Thain's letter in the "Electrical Review" to find an excuse for not complying with the suggestion. Mr. Thain writes: "Compare a gas-cooker costing about £4 with an electric-cooker of the same capacity, priced at about £14. Does £10 represent the actual worth of the difference? It seems almost impossible. Until we have a reliable cooker on the market priced at about £7, with the option of hire-purchase, electricity as a medium for cooking will never be seriously regarded by the middle class." Of course, some of our central station friends will say they have not the power to hire or hire-purchase. Perhaps for their undertakings it is a good thing they have not.

Electrical "Safety."

Our electrical friends are fast enough in laying hold of the incomplete evidence of gas contributing to the firing of trains, but they are not given to making much of accidents in which electricity is concerned. Recently at Newcastle-on-Tyne, there was a collision on the North-Eastern Railway between an empty steam train and an electric one. The damage was great, and several passengers were seriously injured. One morning paper says: "The passengers were naturally thrown into a state of great excitement, which was further increased through the short-circuiting of the live rail, the violent hissing sound of which, accompanied by smoke and jets and sparks of flame, inspired the utmost alarm. Many of the passengers, indeed, thought worse was to follow in the shape of fire, and those who recovered first from the shock made at once for the exits. To reach these, however, was no easy matter." Not many evenings since, pedestrians in High Street North, East Ham, were suddenly alarmed by the falling into the roadway of a live wire connected with the tramway system. The tram service was interrupted for about an hour. Through an accident at the Greenwich generating station on Monday, the 10th inst., as London workers were homeward bound, the whole of the vast southern tramway system was brought to a dead-halt. The paralysis lasted for an hour. During the same day, owing to the failure of current, the tramway service of Shoreditch, Bethnal Green, and Hackney was also suspended for three intervals, aggregating about an hour. On the District Railway just before nine o'clock the same morning, there was a fusing which caused an interruption of the current for about a quarter of an hour. It was a Black Monday for electrical energy in London. Last Thursday week there was a large withdrawal of tramcars on the South London line, through more trouble at Greenwich.

Works' Costs and Breakdowns.

Touching this subject of breakdowns, there is a great struggle going on by central station engineers to bring their works' costs down as low as possible. This is a very laudable thing, so long as it does not mean the sacrifice of works' efficiency and reliability. Mr. R. D. Spurr, writing in the "Electrical Review," declares that this sacrifice is being made by works' engineers; and incidentally he throws light on how works' costs are being reduced in some stations, and how interruptions are, as a consequence, being promoted. He says the primary cause of interruptions of the supply appears to have been forgotten. The reason is decidedly unpleasant to contemplate. It is, that in the effort to reduce the total cost per unit to a minimum figure, the continuity of the supply has been ruthlessly sacrificed, cheapness has been the predominant factor, and has resulted in the acceptance of the lowest tender when installing plant, the purchase of dirty unsuitable coal, the use of hard, muddy water and poor quality oils and grease, continuously overloading antiquated plant, neglected boiler cleaning, patching-up in place of overhauling, continued use of prehistoric switchgear, underpaid, incompetent, short-handed staff, and not providing capital for the purchase of necessary tools, stores, and spare parts. We know of a few other causes; but the list is long enough to go on with. It is Mr. Spurr's deliberate opinion that it is hardly possible now, through their number, to take a census of shut-downs that have occurred in public supply stations.

Dividend Movements.

The following table showing the dividends paid by the London Electricity Supply Companies since 1905 is interesting. Several of the Companies paid better dividends when their business was almost entirely of the lighting order, and of smaller volume than now. Increased business should mean increased dividend, but not with electricity supply, judging by a majority of the London Companies. Others have, with extended business, only maintained a level dividend line. There is something worth investigating about this compilation.

Year	1905	1906	1907	1908	1909	1910	1911	1912
London Electric Supply	4	4	2½	3	2	2	2½	2½
Kensington and Knightsbridge	10	10	10	8	8	9	9	9
County of London*	5	5	5	5	5	5	6	6
City of London	6	6	6	6	7	7	8	9
Chelsea	6	4½	4½	4½	4½	5	5	5
Brompton and Kensington	10	10	10	10	10	10	10	10
Central	*nil*	*nil*	5	5	5	5	5	5
Charing Cross (West End)†	5	5	5	5	5	5	5	5
St. James's and Pall Mall	10	10	10	10	10	10	10	10
Metropolitan	10	8	6½	5½	5	5	4	4½
South Metropolitan	2½	2½	2½	*nil*	*nil*	*nil*	*nil*	*nil*
Westminster	13	12	10	10	10	10	10	10
Notting Hill	7½	7½	7	7	7½	8	—	—
Do., Founders	£3	£3½	£2¾	£3	£3½	£5	—	—
Do., New Ordinary (1s.)	—	—	—	—	—	—	4s. 6d.	5s.
South London	4	3	4	5‡	5	5	5	5

* £190,000 new capital was issued in 1911. † No dividend is paid on the City undertaking. ‡ Shares reduced to £4 by £1 being written off.

Mr. Robert Dempster, founder of the firm of Messrs. Robert Dempster and Sons, Limited, of Elland, whose death was recorded in the "JOURNAL" for the 21st of January, left estate valued at £37,988 gross, with net personalty £37,826.

THE METROPOLITAN GAS COMPANIES' ACCOUNTS.

For the Years 1910, 1911, and 1912.

—	Year ended Dec. 31, 1910. Totals.	Year ended Dec. 31, 1910. Per 1000 C. Ft. of Gas Sold.	Year ended Dec. 31, 1911. Totals.	Year ended Dec. 31, 1911. Per 1000 C. Ft. of Gas Sold.	Year ended Dec. 31, 1912. Totals.	Year ended Dec. 31, 1912. Per 1000 C. Ft. of Gas Sold.
	£ s. d.	s. d.	£ s. d.	s. d.	£ s. d.	s. d.
Capital and borrowed money (including premium capital)	40,158,151 2 8	19 7·82	40,142,763 2 0	19 4·80	40,560,260 10 6	18 7·78
Income—viz.:						
Gas rental	4,988,983 12 3	2 5·30	4,932,271 4 4	2 4·61	5,082,241 15 9	2 4·04
Rental of meters	243,195 19 2	1·43	252,328 14 9	1·47	229,209 8 4	1·26
Rental of stoves, fittings, &c.	386,815 1 11	2·27	411,171 3 9	2·39	505,185 11 0	2·79
Residual products—						
Coke and breeze	971,772 7 0	5·71	1,083,266 10 10	6·28	1,183,118 6 0	6·53
Tar and tar products	191,592 19 9	1·13	226,588 12 7	1·31	263,265 9 11	1·45
Amm. liquor and sulphate of ammonia	346,300 19 11	2·03	378,110 15 11	2 19	421,683 14 5	2·33
Miscellaneous, including old materials	41,546 9 11	0·24	36,858 11 1	0·21	36,365 0 11	0·20
Total income from all sources	7,170,207 9 11	3 6·11	7,320,595 13 3	3 6·46	7,721,069 6 4	3 6·60
Expenditure—viz.:						
Coal and oil, including carriage and dues; also coke and breeze used for making carburetted water gas	2,135,386 16 9	1 0·54	2,135,282 8 3	1 0·39	2,451,164 17 9	1 1·52
Salaries of engineers and officers at works	65,775 15 6	0·39	68,835 16 0	0·40	71,102 1 3	0·39
Wages—manufacture	307,535 17 5	1·80	316,185 17 1	1·83	343,309 11 10	1·89
Purification	55,911 6 1	0·33	83,225 18 8	0·48	88,717 11 6	0·49
Wear and tear—manufacture	735,012 0 9	4·32	778,328 15 2	4·51	829,134 5 6	4·57
Salaries and wages—distribution	154,867 10 6	0·91	161,733 14 2	0·94	173,169 17 1	0·96
Repair and maintenance of mains and services	252,143 0 6	1·48	261,867 3 11	1·52	314,555 7 2	1·74
Repair and renewal of meters, stoves, &c.	635,146 13 9	3·73	642,391 17 6	3·73	708,170 13 9	3·91
Lighting and repairing public lamps	66,110 3 0	0·39	67,609 1 5	0·39	65,889 17 10	0·36
Rents, rates, and taxes	432,246 2 11	2·54	471,324 12 6	2·73	479,929 6 1	2·65
Salaries—management	29,371 13 4	0·17	30,581 12 0	0·18	30,014 3 8	0·17
Collectors' salaries and commission	91,993 10 6	0·54	92,650 15 9	0·54	96,496 15 11	0·53
Stationery, printing, and general charges	56,711 8 10	0·33	58,939 19 1	0·34	62,982 12 7	0·35
Directors and auditors	16,711 17 10	0·10	16,547 19 5	0·10	16,682 0 0	0·09
Co-partnership and profit-sharing schemes	76,065 4 10	0·45	84,473 0 3	0·49	97,507 15 11	0·54
Annuities to officers and workmen	85,828 6 10	0·50	75,421 18 10	0·44	110,360 13 4	0·61
Contributions under National Insurance Act	..	..	..	..	7,171 8 3	0·04
Law and parliamentary charges	12,178 4 5	0·07	7,731 1 9	0·04	6,975 3 3	0·04
Bad debts and extraordinary expenses	28,843 17 11	0·17	29,551 14 0	0·17	23,882 19 1	0·13
Total expenditure on revenue account	5,237,839 11 8	2 6·76	5,382,683 5 9	2 7·22	5,977,217 1 9	2 8·98
Gross profit	1,932,367 18 3	11·35	1,937,912 7 6	11·24	1,743,852 4 7	9·62
Do. per cent. on capital and borrowed money	4 16 3	..	4 16 6	..	4 6 0	..
Do. do. gas-rental	38 14 8	..	39 5 10	..	34 6 3	..

THE LATEST GAS UNDERTAKINGS' RETURNS.

Official Figures as to Gas Supply.

THE returns relating to the gas undertakings of the United Kingdom for the year ended Dec. 31, 1911, in the case of Companies, and March 31, 1912, for the Local Authorities, were issued last Thursday—having been ordered for printing on the 14th of February. The immediately preceding returns were published much earlier; the order for printing having been given on the 14th of December, and the returns being available by the 4th of the following month. The number of pages occupied by the present returns is rather greater than before—103 pages for the Companies, and 61 for the Local Authorities.

Information is furnished in reference to 822 undertakings this year, compared with 809 before. Among the new comers are the Ashbourne and District, Burnham (Essex), Chapel Whaley and District, Chasetown, Chesham and District, Launceston, Llangefni, Llanrwst, Pwllheli (the last three under the Holyhead and North Wales Gas and Water Corporation), Witney and District, Busby and District, and Longford and District; but Swinton and Mexbrough drops out. Among the Local Authorities, there are four new comers—viz., Neath, Swinton and Mexbrough, Fraserburgh, and Kirkcaldy. The total capital authorized (including other purposes than gas supply in certain cases) is given as £159,192,876, of which £136,097,928 has been paid up and borrowed. For the Local Authorities, the capital authorized is £47,697,902, and the amount borrowed £43,108,248. In the case of the Companies, the figures are: Amount authorized, £111,494,974, being £88,922,268 share and £22,572,706 loan capital; amount paid up and borrowed, £92,989,680. The receipts are: Companies, £21,134,770; Local Authorities, £11,184,000—a total of £32,318,770.

The statistics relating to working show that 15,635,012 tons of coal were carbonized; the quantity of gas produced being 205,616,026,000 cubic feet, of which 189,046,549,000 cubic feet were sold. The total make includes 24,684,612,000 cubic feet of water gas and 97,000 cubic feet of acetylene gas. The totals in the preceding returns were: Coal, 15,397,783 tons; gas made, 198,733,354,000 cubic feet; gas sold, 182,833,928,000 cubic feet; water gas made, 23,456,162,000 cubic feet; acetylene gas made, 100,000 cubic feet. At the date to which the latest returns were made up, there were 36,393 miles of mains in use to supply 6,649,904 consumers and 728,548 public lamps. The preceding figures were: Miles of mains, 36,122; gas consumers, 6,417,849; public lamps, 720,785.

Comparing the figures furnished by the present returns with those contained in similar returns for the previous nine years, it will be seen that the Companies show as follows:—

Year.	Share and Premium Capital Paid Up.	Loan Capital Issued.	Receipts.	Expenditure.
1902. . .	£64,299,112	£12,829,925	£17,205,002	£13,167,186
1903. . .	67,417,798	13,451,381	17,756,626	13,214,322
1904. . .	68,953,306	13,775,734	17,828,872	13,397,727
1905. . .	70,605,726	14,176,599	17,617,598	13,410,307
1906. . .	72,008,451	14,467,842	18,166,087	13,671,369
1907. . .	73,152,891	14,645,271	19,567,336	14,884,982
1908. . .	74,328,645	14,944,060	20,013,159	15,475,933
1909. . .	74,952,664	15,168,298	19,951,779	15,097,658
1910. . .	76,797,028	15,396,163	20,446,438	15,308,928
1911. . .	77,382,751	15,606,929	21,134,770	15,903,361

Year.	Tons of Coal Carbonized.	Cubic Feet of Gas Made.	Number of Consumers.	Public Lamps Lighted.
1902. . .	8,520,004	99,676,048,000	2,197,987	333,308
1903. . .	8,528,823	101,490,084,000	2,385,348	335,363
1904. . .	8,673,343	105,311,980,000	2,588,917	343,908
1905. . .	8,722,145	109,823,682,000	2,813,156	350,113
1906. . .	8,922,781	114,528,923,000	3,023,619	356,070
1907. . .	9,240,280	118,699,705,000	3,230,993	362,986
1908. . .	9,281,738	119,985,109,000	3,399,193	367,950
1909. . .	9,175,532	122,930,431,000	3,573,796	369,882
1910. . .	9,236,081	125,830,234,000	3,751,703	371,665
1911. . .	9,431,841	130,562,246,000*	3,906,528	373,203

* Including 18,436,296,000 cubic feet of water gas. Number of cubic feet sold, 119,497,425,000.

The somewhat similar figures for the Local Authorities are—

Year.	Amount Borrowed, including Annuities (not deducting Repayments).	Receipts.	Expenditure (exclusive of Amount in the next Column).	Interest, &c., Paid.*	Net Profit after Payment of Items in preceding Column.
1902-03 .	£35,738,023	£9,554,984	£7,215,502	£1,584,985	£793,764
1903-04 .	37,103,279	9,819,685	7,182,008	1,700,405	967,194
1904-05 .	38,512,295	9,546,682	7,052,474	1,738,682	790,450
1905-06 .	39,401,896	9,636,107	7,085,710	1,799,094	798,210
1906-07 .	40,089,167	9,843,243	7,211,987	1,843,122	832,341
1907-08 .	40,712,159	10,500,416	7,839,122	1,882,427	827,454
1908-09 .	41,435,988	10,506,480	7,998,776	1,905,810	659,445
1909-10 .	42,002,322	10,398,263	7,710,985	1,970,241	767,961
1910-11 .	42,490,504	10,829,758	7,902,451	1,963,015	973,934
1911-12 .	43,108,248	11,184,000	8,161,944	1,990,756	1,045,057

* These figures include: (1) Interest paid on loans; (2) amount paid for annuities; (3) amount of loans repaid; (4) amount paid for redemption of annuities; (5) amount placed to sinking fund.

Year.	Tons of Coal Carbonized.	Cubic Feet of Gas Made.	Number of Consumers.	Public Lamps Lighted.
1902-03. .	5,589,215	60,902,739,000	1,970,738	294,828
1903-04. .	5,673,013	62,717,759,000	1,945,777	301,308
1904-05. .	5,622,259	63,335,696,000	2,148,260	310,275
1905-06. .	5,758,180	65,081,109,000	2,250,919	315,678
1906-07. .	5,923,476	67,312,153,000	2,339,914	321,910
1907-08. .	6,166,473	69,786,988,000	2,434,183	327,278
1908-09. .	6,112,569	69,933,629,000	2,516,927	332,746
1909-10. .	6,049,788	70,616,963,000	2,590,270	343,021
1910-11. .	6,161,702	72,903,220,000	2,666,146	349,120
1911-12. .	6,203,171	75,053,780,000*	2,743,376	355,345

* Including 6,248,316,000 cubic feet of water gas and 97,000 cubic feet of acetylene gas. Number of cubic feet consumed, 69,549,124,000.

As usual, the returns contain particulars in regard to the proportion of water gas used, and also indicate the undertakings in which materials other than coal are employed in the manufacture of gas. The following is a list of the Companies and Local Authorities making water gas; the figures in parentheses showing the maximum proportions (except where averages are stated) of its admixture with coal gas.

Companies.

Aldershot (not stated).
Alliance and Dublin (33).
Aylesbury (not stated).
Barking (31).
Bath (50).
Bexhill (37·02).
Bilston (10).
Bishop's Stortford (47·68, av. 23·98).
Bognor (30).
Bournemouth (36).
Brentford (40).
Bridgwater (25).
Bridlington (av. 33).
Brighton (40·12).
Bristol (17·92).
Bromley and Crays (27).
Cardiff (28·8).
Chigwell (36).
Cleethorpes (17).
Colchester (27).
Commercial (45·33).
Croydon (35·2, av. 23).
Dartford (19·2, one day only).
Dorking (25).
Durham (20 estimated).
Eastbourne (21).
Epsom (43, av. 32·7.)
Falmouth (20).
Felixstowe (20).
Folkestone (33).
Gaslight and Coke (*).
Gosport (25, av. 3).
Gravesend (40, av. 28·7).
Guildford (20 to 25).
Hampton Court (33·5).
Harrow (51, average for one week).
Hartlepool (25, av. 14·2).
Hastings (38·02†).
Hornsey (av. 29).
Horsham (15).
Hull—British (31).
Hythe and Sandgate (40).
Ilford (21·95).
Ilfracombe (12, av. 9·29).
Ipswich (24).
King's Lynn (20·46).
Kingston-on-Thames (20).
Liverpool (50).
Lea Bridge (52).
Londonderry (15, av. 10).
Maidenhead (58, av. 34).
Maidstone (20).
Malton (33).
Marlborough (30).
Merthyr Tydfil (30).
Mid Kent (25).
Mitcham (44·2).
Newcastle-on-Tyne (15·69, one week).
Newport, Mon. (23).
North Middlesex (56·87, one day only, av. 45·9).
Norwich—British (30·7).
Nuneaton (22).
Plymouth (46·33).
Portsea Island (35).
Prescot (not stated).
Preston (36·4, av. for one week).
Ramsbottom (5).
Reading (38·5).
Redhill (34, one day only).
Rhymney (15).
Rochester (41).
Romford (28·5).
Rushden and Higham Ferrers (15·75, av. 9·91).
St. Albans (aver. 33).
Scarborough (26·9).
Southampton (34).
Southend (45·43).
Southgate and District (53·3, av. 37·9).
South Shields (24·18, one day only).
Staines and Egham (25).
Stretford (33).
Swansea (24·9).
Swindon United (43).
Taunton (50, during coal strike).
Tonbridge (25).
Torquay (37·4, av. 25·7).
Tottenham (29·8).
Truro (50).
Tunbridge Wells (25 to 30).
Uxbridge (15·2).
Wandsworth (35, aver. 18).
Watford (32).
Weston-super-Mare (30).
Wexford (25).
Winchester (29).
Wolverhampton (not stated).
York (26·43).

* Of the total quantity of gas sent out by the Company, 10 per cent. was unmixed with water gas. As regards the remainder, 55 per cent. contained a maximum proportion of 29 per cent. of carburetted water gas; 9 per cent., a maximum proportion of 30 per cent.; 10 per cent., a maximum proportion of 36 per cent.; 11 per cent., a maximum proportion of 38 per cent.; 7 per cent., a maximum proportion of 39 per cent.; and 8 per cent., a maximum proportion of 40 per cent. † Average for the year, 26·79 per cent.

Local Authorities.

Aberdeen (25).
Accrington (25).
Ashford (42·7, av. 17·49).
Barrow-in-Furness (22·73).
Belfast (not stated).
Birkenhead (61·66*).
Birmingham (25).
Blackburn (25).
Burnley (70*).
Carlisle (40·02).
Chorley (31·7).
Coventry (16·89).
Devizes (30).
Devonport (58·6*).
Dundee (25).
Edinburgh (27·37).
Halifax (28).
Hebden Bridge (50*, normal 10 to 25).
Leeds (16).
Leicester (13·57).
Leigh (60*, normal 10).
Lincoln (33‡†).
Longton (about 30).
Loughborough (20).
Manchester (18·16 on the total output).
Mansfield (10).
Middlesbrough (no limit).
Nelson (25).
New Mills (25).
Nottingham (13·21).
Oldbury (about 20).
Oldham (37‡).
Pontypridd (29·38, one day).
Rochdale (25).
Smethwick (47*).
Southport (70·51*, norm. 29·15).
Stafford (35).
Stockport (21).
Stockton-on-Tees (30).
Tipton (4·93).
Todmorden (25).
Torquay (32).
Tyldesley (67*, norm. 25).
West Bromwich (56).
Wigan (52*, normal 25).

* During the strike of coal miners. † In daytime; none at night. ‡ At one station only, on one day.

Three new Companies appear in the list—viz., Bristol, Gosport, and Nuneaton; and Bromsgrove drops out. Among the Local Authorities, Halifax, New Mills, Stafford, and Tyldesley appear, and Paisley comes out.

The extent to which oil, petroleum spirit, carburine, or "other material" is being utilized for the production of gas will be seen from the following list of the Companies and Local Authorities making returns.

Companies.

Aldershot.
Alliance and Dublin.
Alton.
Aylesbury.
Barking.
Bath.
Bexhill.
Bilston.
Bishop's Stortford.
Bognor.
Boston.
Bournemouth.
Brentford.
Bridgwater.
Bridlington.
Brighton and Hove.
Bristol.
Broadstairs.
Bromley and Crays.
Canterbury.
Cardiff.
Chapel Whaley.
Chigwell.
Cleethorpes.
Colchester.
Commercial.
Croydon.
Dartford.
Derby.
Dorking.
Dover.
Durham.
Eastbourne.
East Grinstead.
Epsom and Ewell.
Exeter.
Falmouth.
Fareham.
Felixstowe.
Ferndale.
Folkestone.
Gaslight and Coke.
Gosport.
Grantham.
Gravesend.
Guildford.
Hampton Court.
Harrow and Stanmore.
Hartlepool.
Hastings.
Hornsey.
Horsham.
Hull (British Co.).
Hythe and Sandgate.
Ilford.
Ilfracombe.
Ipswich.
Isle of Thanet.
King's Lynn.
Kingston-on-Thames.
Lampeter.
Lea Bridge.
Liverpool.
Londonderry.
Maidenhead.
Maidstone.
Malton.
Marlborough.
Merthyr Tydfil.
Mid Kent.
Mitcham and Wimbledon.
Newcastle-upon-Tyne.
Newport (Mon.).
North Middlesex.
Norwich (British Co.).
Nuneaton.
Plymouth.
Portsea Island.
Prescot.
Preston.
Ramsbottom.
Reading.
Redhill.
Rhymney & Aber Valleys.
Rochester.
Romford.
St. Albans.
Scarborough.
Sevenoaks.
Shrewsbury.
Southampton.
Southend.
Southgate and District.
South Shields.
Staines and Egham.
Stirling.
Stretford.
Swansea.
Swindon.
Taunton.
Tonbridge.
Torquay.
Tottenham.
Truro.
Tunbridge Wells.
Tynemouth.
Uxbridge.
Wandsworth and Putney.
Watford.
Weston-super-Mare.
Wexford.
Winchester.
Wolverhampton.
York.

Local Authorities.

Aberdeen.
Abergavenny.
Accrington.
Airdrie.
Alloa.
Alva.
Arbroath.
Ashford.
Barrow-in-Furness.
Belfast.
Birkenhead.
Birmingham.
Blackburn.
Blackpool.
Burnley.
Carlisle.
Chorley.
Coventry.
Darwen.
Devizes
Devonport.
Dumfries.
Dundee.
Edinburgh and Leith.
Eflon (gas oil only).
Falkirk.
Glastonbury.
Greenock.
Halifax.
Hebden Bridge.
Helensburgh.
Heywood.
Kilmarnock.
Kirkintilloch.
Leeds.
Leek.
Leicester.
Leigh.
Lincoln.
Liverpool (Fazakerley).
Llandudno.
Longton.
Loughborough.
Manchester.
Mansfield.
Middlesbrough.
Mossley.
Neath.
Nelson.
New Mills.
Nottingham.
Oldbury.
Oldham.
Paisley.
Perth.
Pontypridd.
Portsoy (acetylene gas).
Rhyl.
Rochdale.
Smethwick.
Southport.
Stafford.
Stockport.
Stockton-on-Tees.
Tipton.
Todmorden.
Torquay (St. Mary Ch.).
Tyldesley.
Walsall.
Warrington.
West Bromwich.
Wigan.

The new names in the preceding lists are the Chapel Whaley, Ferndale, Gosport, Nuneaton, and Sevenoaks Gas Companies, and the Halifax, Kilmarnock, Neath, New Mills, Rhyl, Stafford, and Tyldesley Local Authorities. The Bromsgrove, Bude, and Littleborough Companies, and the Ballymena, Dalton-in-Furness, and Middleton Local Authorities drop out.

The Gas Commissioners of Portsoy used 10 tons of carbide of calcium in the manufacture of 97,000 cubic feet of acetylene gas, of which 71,000 cubic feet were employed for private and 25,000 cubic feet for public lighting—together 96,000 cubic feet, at the price of 4s. 9d. per 100 cubic feet. At the date to which the returns were made up (March 31 last), there were 68 consumers, about four miles of mains, and 72 public lamps.

We learn from the Hon. Secretary of the Manchester and District Junior Gas Association (Mr. J. Alsop) that arrangements have been made for the members to visit the St. Helens Gas-Works, on the invitation of Mr. Samuel Glover, M.Inst.C.E., the Engineer and Manager, next Saturday afternoon. At the close of the inspection, the visitors will be entertained by Mr. and Mrs. Glover at tea in the Mayor's Reception Room at the Town Hall. After tea, Mr. Roland B. Glover will read a paper entitled "Some Experiences in the Construction and Working of Vertical Retorts." The meeting will be held in the building, by permission of the Town Hall Committee. The fourteenth annual meeting of the Association will take place in the Exchange Hotel, Manchester, on Saturday, the 5th prox., when the report and accounts will be presented, and members of the Council and officers elected. The new President will be introduced, and will deliver his Inaugural Address.

THE ACCIDENT TO A GASHOLDER AT ILKESTON.

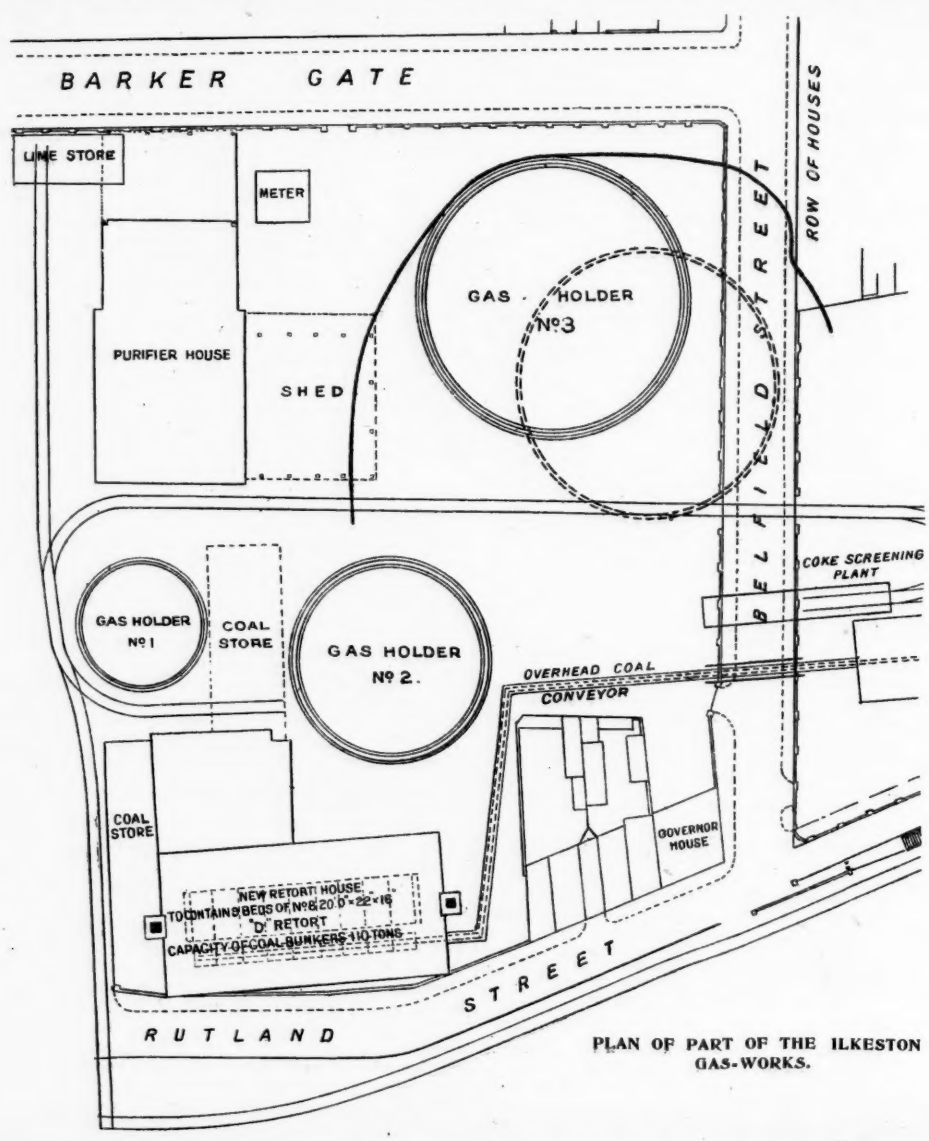
Report by Mr. A. G. DRURY, M.Inst.C.E.

THE report of Mr. A. G. Drury, M.Inst.C.E., who conducted the inquiry into the causes of, and the circumstances attending, the accident which occurred to a holder at the gas-works of the Ilkeston Corporation on the 8th of January, 1912, was issued last Monday evening—too late for notice in the number of the "JOURNAL" published the next day. It is dated Nov. 11, 1912, and is addressed to the Home Secretary (the Right Hon. Reginald M'Kenna, M.P.). It is a long document, and contains numerous diagrams and illustrations. The principal portions of it are given below.

The report opens with some preliminary particulars in regard to the inquiry, which was held in the Town Hall, Ilkeston, on June 18 and 19 and July 9, 1912, and reported in the "JOURNAL" at the time. [See Vol. CXVIII., p. 995, and Vol. CXIX., p. 206.] The names of those present, as representatives of the Factory Department of the Home Office, of parties interested, and as witnesses, are given. There were twenty-one witnesses—nine on behalf of the Corporation (including Mr. Samuel Glover, of St. Helens, and Mr. J. Ferguson Bell, of Derby), two put forward by the makers of the holder (Messrs. C. & W. Walker), and the rest, among whom was Mr. W. Doig Gibb, the Chief Engineer of the South Metropolitan Gas Company, were called by the Inspector. At the end of the third day, as there did not appear to be available any further evidence of eye-witnesses of the accident, and as the Inspector did not consider that any useful purpose would be served by calling any more expert evidence, he declared the inquiry closed.

In the course of the investigation, the Inspector visited the gas-works; but the remnants of the holder and tank had been removed, and the damage to the surrounding works and property had been practically made good. However, for the purpose of a report to the Local Government Board, he paid a visit to the works three days after the accident; and though at that time he was not called upon to make a very critical examination of the broken tank, or to question any of the men, he made himself acquainted with the main facts of the case. In order to glean information bearing on the accident, he also, during the adjournment of the inquiry and after its close, visited various other gas-works in the country where spiral-guided holders, working both in underground and in steel tanks, are in use.

A general plan of the works was put in by Mr. F. C. Humphrys, the Engineer and Manager; and the portion specifically concerned with the accident is reproduced. The holder and tank forming the subject of the investigation is No. 3 on the plan; and its position as erected is shown in black. The dotted circle shows the place to which the holder was carried and dropped by the water let loose from the tank; and the thick black line indicates the position of the tank sides after the disaster. As a result of the bursting of the tank, the fence walls on both sides of Belfield Street were knocked down and swept away, as was also a part of the wall along the railway near the footbridge. The houses in Rutland Street next to the governor-house were also badly cracked and damaged by water; and a row of houses in Belfield Street and a shed in the yard were partially demolished by the impact of the tank sides, which were torn away from the bottom to the extent of three-fourths of the circumference. Railway trucks which at the time were standing on the siding near the tank were also carried away—one against the back of a house in Rutland Street, and another against holder No. 2. The latter, which was full of gas at the time, was badly damaged by the blow, with the result that the gas escaped and the holder subsided into its tank, which is a brick structure below the ground level. The gas



PLAN OF PART OF THE ILKESTON GAS-WORKS.

escaping from both holders became ignited and burnt away, but there was no explosion.

The Damaged Holder and Tank.

Mr. Drury gives full particulars of the holder, which, as readers of the "Journal" may remember, was a two-lift spiral-guided one on the Gadd and Mason principle, contained in a steel tank placed entirely above ground. It was first brought into use on April 20, 1909, and was provided by means of a loan that was sanctioned by the Local Government Board the preceding year. Mr. Drury points out that the proposal submitted to, and approved by, the Board was for a spiral-guided holder in a brick and puddle underground tank, but that the Corporation ultimately decided to adopt a steel tank. "This alteration in their proposal was," he says, "not communicated to the Local Government Board, as it should have been; and no drawings of the steel tank were submitted for the Board's approval." Tenders for the work were not advertised for; but several selected firms were invited to submit alternative designs, specifications, and estimates, and these were sent in for a columnless holder and steel tank; the holder and tank being quoted for separately. Tenders were also obtained for a brick tank; and one quotation was received for a column-guided holder and steel tank.

The Inspector says the reason given for the adoption of a steel tank was that the Corporation were advised that, in view of possible subsidence of the surface due to coal workings, a steel tank would be more suitable than one of brick or concrete; moreover, it was represented that time was an object, and that a steel tank could be more speedily erected. Messrs. Walker's tender of £5086 was the lowest sent in; and, as this firm were acknowledged to be of good repute, it was accepted. The highest tender received was £6032; but Mr. Drury says it is a matter for remark that, though this price for the combined holder and tank was considerably higher than that quoted by Messrs. Walker, the price included for the tank by itself was slightly lower. It is also a fact that the lowest tender sent in for a brick tank was only about 5 per cent. in excess of that accepted for the steel tank. Notwithstanding this, however, and the fact, as was admitted at the inquiry, that the two existing underground tanks at the works have not been damaged in any way by subsidence, the steel tank was adopted; and the justification for this decision was endorsed by Mr. Bell and other engineers.

Drawings of the holder and tank, giving details of construction, were put in by Mr. Bell. They were similar to those given in the "Journal" for Feb. 6, 1912 (pp. 356-7). The construction of the two lifts of the holder was of the usual type, and did not call for any special remark by the Inspector. That of the tank, on the other hand, was of importance; and he gives the following particulars in regard to it: The sides consisted of six tiers of plates, each 4 ft. 3¼ in. deep between the centres of the horizontal joints, and they varied in thickness from $\frac{9}{16}$ inch at the bottom to ¼ inch at the top; each tier of plates being $\frac{1}{16}$ inch less in thickness than the one below it. All the vertical joints were lapped and doubled riveted, except those in the top plate, which had a single row of rivets only. The horizontal joints were also lapped and single riveted. The floor of the tank consisted of ¼-inch plates, with a 2 ft. 6 in. width of $\frac{5}{16}$-inch plate round the outer edge; and this outer plate was connected to the vertical sides by a 5 in. by 5 in. by ½ in. angle bar. The top edge of the tank was stiffened by two angle kerbs and an external ¼-in. chequered plate gangway, 2 ft. 6 in. wide, supported on gussets. The tank side was stiffened vertically under each roller carriage by a pair of angle bars riveted to the outside, and extending down two-thirds the depth of the tank. The material employed was basic Bessemer steel; and the rivet holes throughout were punched. No holes were drilled or reamered.

Mr. Drury states that the makers' design and specification were accepted without question. No limiting working stresses were laid down; and no tests were specified for the steel. The specification merely stated "the materials and workmanship will be of the highest quality, and to entire satisfaction of the engineer." No attempt was made on behalf of the Corporation, either by the gas manager or by an independent engineer, to check by calculation the strength or sufficiency of the design; and no steps were taken by them to satisfy themselves as to the quality of the material; it being considered that the good repute of the makers was a sufficient guarantee that the work would meet all requirements of the case.

Mr. Humphrys stated, however, that the several specifications and designs were compared in a general way, and were found to be substantially in agreement as to the main scantlings to be employed; but the Inspector considers it "a matter for regret that all the papers and drawings other than those connected with the accepted tender have since been destroyed, so that the designs cannot be more closely compared." That the work compiled with the makers' specification in every way, and was well put together, was admitted on all sides. Mr. Humphrys stated that he personally supervised the erection on the site, and was quite satisfied with the work, and had no hesitation in certifying for its payment.

Although no specific tests were mentioned in their specification, Messrs. Walker, in the ordinary course of their practice, required tests of the material at the rolling-mills; and the result of them, together with those of the analysis of the material, are given in Appendix A. The minimum tensile breaking stress laid down in the British Standard Specification for structural steel for bridges and general building construction and for shipbuilding is 28 tons per square inch, with an elongation of not less than 20 per cent. on 8 inches. In the case of structural steel also, analysis must not show the presence of more than 0·06 per cent. of sulphur or from 0·06 to 0·07 per cent. of phosphorus; so that the results of the rolling-mill tests, although somewhat below those recommended by the British Standards Committee, do not give any serious cause for complaint. Since the accident, further tests have also been made of the fractured plates at the instance of Messrs. Walker, Mr. Bell, and Mr. Glover; and these, which are given in another appendix, give rise to some concern, as not only do they not confirm the original tests made of the casts, inasmuch as some of the specimens broke at about 25½ tons per square inch, but the analyses indicate that an unduly high percentage of phosphorus was present in the material, and that the plates were inclined to be brittle. They also indicate considerable variation in the quality of the material. In order to obtain corroboration of the low tensile tests obtained, and to further test the steel for brittleness, Mr. Drury caused supplementary tests—tensile, bending, and microscopical—to be made from pieces of the same plate and of the adjoining one; and the results, which are given in another appendix, are, he says, quite in keeping with those put in at the inquiry. The material was, in fact, uneven in quality and undoubtedly brittle.

After some remarks on the behaviour of the holder and the circumstances of the accident, the Inspector deals as follows with the

Views of the Engineering and Expert Witnesses.

At the time of the accident, the holder was being used not only to supply the town but to fill holder No. 2; and the practically unanimous conclusion arrived at by the gas manager and the experts called on behalf of the Corporation and the makers was that the immediate cause of the disaster was the jamming of the outer lift during its descent. They were unanimous in attributing the failure of the tank to its having been subjected to some severe and abnormal strain; and they were at a loss to understand how, except by a jam, such a strain could have been thrown upon the tank as to cause its fracture.

The consequence of a jamming and holding-up of the outer lift would be the unsealing of the inner lift and the escape of gas. As a result of this, the inner lift would drop; and it was thought that the shock or jar communicated through the roller carriages to the top of the tank, combined possibly with the effect of the great heat generated by the burning gas, which by some means became ignited, must have brought about its fracture. This was the conclusion arrived at by Mr. Humphrys, as a result of his inquiries and investigation into the occurrence; and he based it largely on the fact that the inner lift had been actually seen by somebody to telescope into the outer while the latter was still up in the air. But no direct evidence of this was forthcoming.

Messrs. Glover and Bell, who had also made a careful investigation of the circumstances after the accident, admitted that they could find no evidence that the outer lift had stuck, and that the theory advanced was based mainly on supposition. All agreed that, whatever the cause of the accident, it could not be attributed to any defect in the design or construction of the holder itself, as, except for the denting-in of the bottom edges of the lifts, and the scorching and buckling of the plates by fire, it was intact and still gas-tight when it reached the ground. The holder was, in fact, so little damaged that, after being put in thorough repair, it is to be used again in another tank.

It was also generally conceded that the disaster could not seriously be attributed to anything in the weather conditions which prevailed at the time. According to the meteorological records, there had been 7° of frost in the neighbourhood the preceding night; and, according to the evidence, this was followed by a sunshiny morning and a high wind with squalls in the afternoon. But it was generally admitted that the conditions, though changeable, could not be regarded as in any way abnormal. The theory that the outer lift must have jammed as it was descending was endorsed by Professor Adams and Mr. Milbourne [the Contractors' witnesses], who were unable to explain how otherwise strain sufficient to break the tank could have been brought upon it.

The suggestion was made that possibly the fall of the inner lift was due to a destruction of the water-seal through leakage. Evidence was given to the effect that lifts had been known to come down in this way, and that a leakage of water in the cup might have occurred through a piece of waste or rope acting as a syphon, or by syphonage through the pipes of the anti-freezing apparatus. But Mr. Humphrys pointed out that in the present instance the emptying of the cups by the anti-freezing apparatus was impossible, as the pipe nozzles only extended about an inch below the top water-line.

To account for the holder jamming, it was suggested that it might possibly have been occasioned by a stone or piece of wood thrown from the road having lodged in one of the guides. That children are very prone to throw articles at gasholders cannot be disputed, as stones are often to be seen lying on the domes or on the ground at the sides of such structures wherever they happen to be within easy range of roads or gardens adjoining gas-works. Mr. Milbourne gave an instance where this risk had been regarded in so serious a light by a municipal authority, that they had asked his firm to devise some form of shield to protect the roller carriages. But, on going into the matter, they had come to the conclusion that the provision of guards in such a position might be dangerous in other ways.

None of the witnesses examined had ever known of a spiral holder actually becoming jammed. But Mr. Doig Gibb said there had certainly been cases where some jamming had taken place in the early days of this form of holder, because rollers had been broken off; and I have myself recently seen an instance of roller-pins being badly bent as a result of pressure from the guides. In this connection also I may state that I have come across a well-authenticated case of the bottom lift of a three-lift spiral holder of one of the earlier types becoming jammed. In this instance, the jam was put down to the deformation of the holder under the influence of a very hot sun on one side of it; and it resulted only in a fall of the inner lifts and a loss of the gas. The bottom lift was so damaged, however, that it has never since been used. The holder in question was in a cast-iron tank, partly sunk and partly banked round with earth; and the gas did not happen to become ignited.

Mr. Milbourne testified to the fact that the pattern of guides and rollers provided by his firm had always worked excellently; and though complaints had sometimes been received that they were not working properly, on being investigated it had invariably been found that the parts had not been kept properly oiled, or that some slight adjustment was required. He emphasized the necessity for careful examination in the case of a moving machine like a gas-holder, and for the adjustment of the rollers from time to time, especially in the earlier stages of working.

As evidence that the inner lift must have become unsealed first, Mr. Milbourne said there were marks of fire upon it as far down as the cup; and he expressed the opinion that the gas must have escaped and become ignited before the tank burst. In support of their contention that the holder must have jammed first and caused the destruction of the tank, Mr. Bell and Mr. Glover said the fact of the tank having stood for three years was against the assumption that it could have failed under a merely normal pressure. Some extreme strain must have been thrown upon it. If it had been otherwise, as Mr. Glover admitted, the tank must have been already on the point of bursting, and that it only required some emphasizing of the normal conditions to cause its failure. To accept the view that the tank must have been on the point of bursting all the time, was, however, such a severe criticism on it, that the other explanation was the one which appealed to him.

As to how the escaping gas became ignited, the explanation offered by Mr. Humphrys was that ignition must have been caused by the sparking of metal against metal during the rapid telescoping of the inner lift. So far as he knew, there were no fires or lights burning near the holder at the time; and I ascertained that though there were street lamps near, with incandescent burners, the latter were not fitted with bye-passes. There must also have been fires in some of the houses adjoining the works; but the only evidence of one to which the gas may have obtained access was the stove that was burning in an outhouse in the back yard of a cottage in Rutland Street. All the other experts considered that ignition by friction sparks was the most reasonable explanation; and Mr. Gibb expressed the opinion that the gas must have become ignited immediately it issued from the holder, because if it had been ignited by a light in one of the cottages outside the yard the quantity of gas diffused through the air would probably have resulted in a tremendous explosion.

None of the gas engineers or managers had a word to say against the use of spiral-guided holders; and all agreed that this type of holder was perfectly safe and satisfactory in its working though it required more attention than a column-guided holder They also agreed that it gave a steadier pressure. No exception was taken, either, to the use of steel tanks for gasholders, though Mr. Glover said that, in view of the far-reaching effects of a burst, he would prefer to sink such tanks into the ground. The other experts, however, were content to place them above ground, provided, of course, that they were properly designed and of sufficient strength. Mr. Bell pointed out that steel tanks possessed decided advantages over pit tanks in cases where ground is waterlogged or is liable to subsidence. Moreover, they are more speedily erected; and in the event of any unequal subsidence taking place, they are capable of adjustment in level. He drew attention to the fact that they had come extensively into use during the past twenty or thirty years, as illustrated by the following figures, which he had obtained from the leading makers of tanks for gasholders and other purposes:—

—	Steel Tanks for Gasholders.		Steel Tanks for Storage of Oil, &c.
	Column-Guided.	Spiral-Guided.	
1892–1896 inclusive . . .	49	19	29
1897–1901 ,, . . .	78	28	51
1902–1906 ,, . . .	95	54	70
1907–1911 ,, . . .	91	98	89
	313	199	239

Mr. Bell was decidedly of opinion that the Corporation had acted wisely in putting up a steel tank at Ilkeston; and he stated that during the past five years 80 per cent. of the gasholders erected have steel tanks. Upon the figures in the above table, the accuracy of which I do not doubt, the use of these tanks for spiral-guided holders certainly appears to be steadily increasing in favour.

Calculations of the strength of the tank plates to resist the bursting pressure of the water were put in by Mr. Bell;* and to make them more complete I have added thereto particulars of the stresses in the riveted joints in each tier. These calculations, it is to be observed, are based on the assumption that 27 tons per square inch was the ultimate breaking stress of the steel; and it is also to be noted that the effective head of water on each tier has been taken at two-thirds the depth of the plate, which method of calculation does not give the absolute maximum intensity of the pressure on each tier.

—	Bottom Tier.	Second Tier.	Third Tier.
Shearing stress per sq. in. on rivets (single shear). Bursting pressure ÷ Net area of rivets	$\frac{166{\cdot}25}{30 \times {\cdot}6013}$ = 9·2 tons per sq. in.	$\frac{138}{35 \times {\cdot}4417}$ = 9 tons per sq. in.	$\frac{108}{35 \times {\cdot}4417}$ = 7 tons per sq. in.
Bearing pressure per sq. in. of rivet holes. Bursting pressure ÷ Thickness of plate × diameter and number of rivets.	$\frac{166{\cdot}25}{\frac{9}{16} \times 30 \times \frac{13}{16}}$ = 10·5 tons per sq. in.	$\frac{138}{\frac{3}{4} \times 35 \times \frac{13}{16}}$ = 9·7 tons per sq. in.	$\frac{108}{\frac{7}{16} \times 35 \times \frac{13}{16}}$ = 8·7 tons per sq. in.

—	Fourth Tier.	Fifth Tier.	Sixth (Top) Tier.
Shearing stress per sq. in. on rivets (single shear). Bursting pressure ÷ Net area of rivets	$\frac{79}{43 \times {\cdot}3068}$ = 6 tons per sq. in.	$\frac{50}{43 \times {\cdot}3068}$ = 3·8 tons per sq. in.	$\frac{20{\cdot}5}{27 \times {\cdot}3068}$ = 2·5 tons per sq. in.
Bearing pressure per sq. in. of rivet-holes. Bursting pressure ÷ Thickness of plate × diameter and number of rivets.	$\frac{79}{\frac{9}{16} \times 43 \times \frac{13}{16}}$ = 7·1 tons per sq. in.	$\frac{50}{\frac{9}{16} \times 43 \times \frac{13}{16}}$ = 5·4 tons per sq. in.	$\frac{20{\cdot}5}{\frac{1}{4} \times 27 \times \frac{13}{16}}$ = 4·4 tons per sq. in.

On the question of design and of the strength of the tank, the evidence was to the effect that it was in accordance with the prevailing practice, and similar to a large number of tanks which have been erected both at that time and since. Mr. Glover and Mr. Bell said that, with this knowledge before them, they might themselves at the time have accepted the design; but they agreed that the tank was on the weak side, and that they would have preferred that there should have been a larger factor of safety than $3\frac{1}{2}$, which, as will be seen from the table of stresses put in by Mr. Bell, was the theoretical factor in the bottom side plates. These witnesses agreed that a factor of safety of at least 4 should be provided in steel gasholder tanks, and that in the case of tanks for spiral-guided holders it should perhaps be even more.

Professor Adams considered that the tank was strongly designed, and had been made very stiff. As regards the margin of safety provided, he stated that a factor as low as 3 was frequently allowed in the bottom plates, where the strain to be provided for was solely that due to the static pressure from the water. He could see no weak part in the structure; but at the same time he was bound to admit that if he had been responsible for the design, he might have increased the thickness of the bottom side plates. He admitted also that the joints were theoretically somewhat weak in the riveting; but he pointed out that, this notwithstanding, the fact remained that, with some slight exceptions, it was not the rivets that sheared, but the plates that had gone when the tank burst.

Messrs. Bell and Glover also took exception to the sufficiency of the joints in the matter of width of lap and pitch of rivets; and the latter expressed a preference for butt-joints cover-plated on both sides for plates exceeding $\frac{1}{2}$ inch thick. Mr. Glover also thought the excessive overhang of the roller carriage might have had something to do with the failure of the tank; and this opinion was endorsed later by Mr. Gibb.

Mr. Milbourne, who said that many hundreds of tanks for holders for gas, water, and oil had come under his notice, testified to the fact that $3\frac{1}{2}$ was a factor of safety usually employed by Messrs. Walker and other firms who manufactured these tanks, and that the failure which had occurred at Ilkeston was the first of the kind that Messrs. Walker had ever had. In calculating the average pressure on the side plates of a tank, it was the practice of his firm to take the pressure acting at the centre of the plates and not at two-thirds the depth, as Mr. Bell had done; and on this basis the factor of safety on the bottom tier of plates, assuming the ultimate breaking stress of the metal to be 27 tons per square inch, would be 3·73. From this figure it increased in each succeeding tier until at the top, taking the area of the plate alone, a factor was obtained of over 10. But the top plate was further strengthened with two angle-iron curbs and a plate gangway supported on brackets, which gave rigidity to the structure, and took up the wind and other stresses which had to be provided for; and if these were added to the area of the plate, it gave a factor of 49. He explained that in the case of a tank for a column-guided holder, the only difference made would be the omission of the lower of the two angle-iron curbs on the top plate, and a reduction in the strength of the top curb. But the thickness of the side plates would be the same. He considered the design of the top curb the important point in the case of a spiral-guided holder;

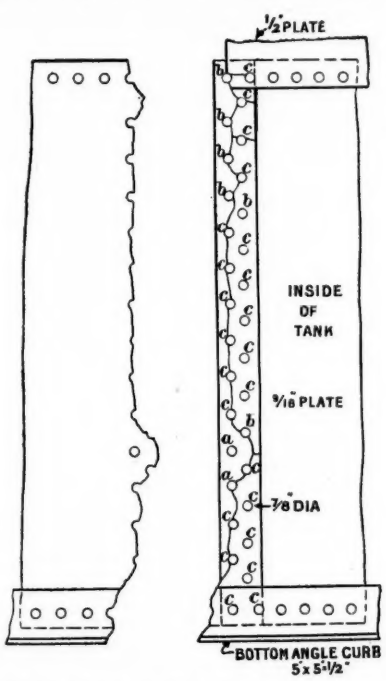
* These calculations are given in an appendix to the report. They will be found in the "JOURNAL" for Feb. 6, 1912 (p. 355).—ED. J.G.L.

and in the tanks designed by his firm since the Ilkeston accident they had strengthened this part of the structure. But they still saw no reason to depart from the factor of 3½ for the bottom of the tank, because it is a definitely known stress that has to be withstood at this point.

Mr. Milbourne acknowledged that consulting engineers, as a rule, provide, or require, a larger factor of safety; and he admitted quite frankly that when his firm knew they were tendering in competition with others, they cut down the factor of safety, but they never reduce it to less than 3½, which he considers should be the minimum.

From the list of gasholders with steel tanks published in Messrs. Walker's catalogue of 1911, the main particulars have been supplied to me of fifteen tanks of the larger size, which I had picked out at random. Their dimensions vary from 84 to 145 feet in diameter; and of the total number, nine are for column and six are for spiral guided holders. Four of the former, and one of the latter, had been designed by consulting engineers, and the remainder by Messrs. Walker; and the factor of safety allowed in the bottom tier of plates, calculated on the same basis as the figure of 3·73 for the Ilkeston tank, varies from 3·1 to 4·85. The tank with the lowest factor mentioned was for a column-guided holder, which, as it happened, was designed by an outside engineer; while some of those with a factor exceeding 4 were designed by the firm. So that, on the face of it, the latter's designs do not compare unfavourably with those of independent engineers. But there are other points to be taken into consideration, such as the form of joints used, the quality of the steel, and whether the rivet-holes were drilled or punched. Mr. Milbourne explained that the higher factor adopted by the firm in some of the instances given might have been due to their knowledge that no other firm had been asked to quote, or else to their having been specially asked to submit a substantial design. But he said that, as a rule, they tender in competition with other firms; and in such circumstances, in order to get a chance of obtaining the order, they are obliged to adopt a lower factor.

The views of Mr. Doig Gibb did not coincide with those of the other experts; and he was disposed to attribute the disaster directly to the inherent weakness of the tank. He preferred, he said, to look for a natural rather than an artificial cause; and this was to be found in the bottom plates, just above the curb, where he thought it could be shown that there was a factor of safety of only a little over 2. His calculation, which he sent me later, showed that this was on the rivet area in shear, and not in the actual plate area against tension. But, as a matter of fact, it was the plates that gave way at this point, not the rivets; so the inference is that, notwithstanding the weakness of the rivets in shear, the plate was weaker still. Mr. Gibb said he had also calculated the strength of the top curb, and had found that, assuming a wind pressure of 41 lbs. per square foot (the Continental standard), the metal would be stressed to about 20 tons per square inch. He admitted that it was the practice of English engineers to allow for a wind pressure of only 28 lbs. But during the last two or three years as much as 65 lbs. had been recorded; and a gasholder might be momentarily subjected to a wind pressure as high as 41 lbs. His point was, that if a steel plate is subjected to something like 20 tons per square inch two or three times during its working life, its power to resist tensile stress of even less intensity is reduced. He was strongly of opinion that in the case of a steel gasholder tank, a factor of safety of at least 4 should be provided, and in the case of such tanks above ground he would exceed this figure, because the consequences of a burst might be so serious. He had just finished putting up in London two tanks above ground for holding creosote; and though they were plain tanks he had adopted a factor of safety of 8.



Two rivets marked *a*, sheared off.
Three ,, ,, *b*, nobbled heads torn off and were pulled out.
Twenty ,, ,, *c*, intact
Bottom angle curb on vertical seams, two rivets intact.
Top horizontal seam, one rivet intact, the other pulled out.

Sketch showing Line of Fracture on Bottom Plate of Ilkeston Gasholder Tank.

With the exception of Mr. Bell, who was unable to say anything definite on this point, the experts called by the Corporation and the makers were of opinion that the tank fracture must have commenced at the top, where the strain from the jamming of the holder would naturally first be felt. Professor Adams, from an examination of the drawing of the fractured joint in the bottom plate [see accompanying diagram], was very decidedly of opinion that it was not brought about by a purely tensile stress, but was due to a tear which had commenced at the top and run downwards. He based this conclusion upon the fact that, though the rent ran through the rivet-holes of the plates, the heads of the four upper rivets in the joint had been torn off, which, in his view, pointed to a sideways action such as would occur when tearing a piece of paper. Mr. Gibb, on the other hand, did not believe that there could have been any jamming of the holder; and he was inclined to think that the fracture commenced at the bottom and extended upwards, because, though all the tank was weak, the bottom part was weakest.

As regards the quality of the steel used, which, according to the tests carried out since the accident, was of a brittle character, the makers' representatives contended that this had little bearing on the case, because the fact of the material being brittle would not affect its tensile strength under a steady pressure, and would only become apparent if the metal were subjected to a blow or sudden shock. But Mr. Gibb, while agreeing with this expression of opinion, pointed out at the same time that brittle steel is more liable to be adversely affected by sudden changes of temperature; and the brittle effect had probably been intensified by the punching of the holes in the plates.

Remarks.

In the absence of direct evidence as to the exact sequence of events which preceded or accompanied the bursting of the tank, it is impossible to say definitely what was the immediate cause of the disaster. But, whatever the cause, it is equally impossible to avoid the conclusion that the tank was weak. Not only was it too light in construction, but, as it now transpires, the quality of the material used was by no means all that could be desired.

Although the inquiry has not been conclusive as to the exact manner in which the accident occurred, one satisfactory result of it has, I think, been to establish the fact that the spiral-guided type of holder is one that may be safely adopted, provided it is contained in a properly-designed tank, and reasonable care and attention are given to the working and adjustment of the roller carriages in relation to the guides. It was also, I think, established that the disaster is not to be attributed to any defect in the design or construction of the holder itself. This being so, the investigation becomes focussed mainly upon the tank. Any idea that the disaster was directly attributable to the atmospheric conditions prevailing at the time may also be dismissed, because, though changeable, the weather was not abnormally severe; and there appears to have been no excessive variation in temperature. It is possible, however, that the tank structure may have been already over-strained, and its resisting power to some extent reduced, by gales and storms previously encountered during its working life. But to what extent this may have been the case it is impossible to say.

The suggestion put forward by some of the witnesses, that because the tank had stood for this length of time it might be expected to continue to withstand the ordinary working strains, is certainly not a sound argument; for it is a well-known fact that structures which during their life have been overstressed, or possessed some hidden flaw, have finally given way under a load considerably less than that which they had previously been called upon to bear.

Probable Cause of the Accident.—Upon the evidence alone, it is impossible to say whether the tank burst first merely under the static pressure of the water, or whether its fracture was brought about by some abnormal strain thrown upon it by the holder, because the period occupied by the whole catastrophe was so short that, whatever happened, almost any conceivable sequence of events might be made to agree with the impressions of some, though not of all, the eye-witnesses.

If the tank did give way merely under the pressure of the water contained in it, one would naturally have expected the first fracture to have occurred at the bottom, because it was theoretically the weakest place. The metal at this point, as shown by the result of the tests since carried out, was being stressed probably up to about one-third its breaking stress; and, furthermore, if it is considered what the effect would be of punching holes in plates of a brittle character, it is to be feared that at the bottom tier of plates the factor of safety might have been even less than 3. Yet even this would not be sufficient to account for the failure of the tank from pure static pressure.

But examiation of the actual bottom plate which fractured inclines me to the belief that the rip did not commence at the bottom, but at some point higher up the tank side, and that it extended downwards. I am led to this conclusion by the fact that the bottom angle curb had opened till in places it was almost flat, and that the outer edge of the floor plating had been bent downwards and torn just clear of the rivets connecting it with the curb. This, coupled with the fact that the heads of the four or five rivets at the top of the vertical joint were pulled off as if by a sideways action, to my mind, points to the bottom plate having been fractured by a tear which reached it from above. This view also meets with corroboration in the evidence of the only witness who appears to have actually observed what took place—viz., Pierrepont—who said that the water seemed to first burst out from a rent in the upper part of the tank.

If this was the case, it looks as if the first fracture must have been due to the effect of a vertical load on the tank side, rather than to the steady horizontal pressure exerted by the water—a pressure which the upper part of the tank was better able to withstand than the bottom. And this leads one naturally to the assumption that the weight of the holder must in some way have been suddenly thrown upon the top edge of the tank—possibly through the unsealing of the inner lift, as was suggested by the majority of the experts who gave evidence. This unsealing of the inner lift might have been caused either by an unsuspected leakage of water from the cup, or by a temporary jamming or retardation of the outer lift during its descent, or possibly by a combination of both. The unsealing of gasholder lifts by leakage is, it appears, by no means unknown; and though there is, I believe, no recorded instance of an actual permanent jam ever having occurred in the case of a spiral-guided holder of modern construction, still, as a result of my inspection of existing holders of this type, I am satisfied that there is sometimes considerable friction in the working of guides and rollers, and to such an extent that the bottom lift of a holder might be held up long enough to bring about destruction of the water-seal in the lift above.

That something of this sort did occur seems to me to afford the most reasonable explanation of how such an extra strain could have been thrown on the upper part of the tank side as to cause it to fail, because the effect of a sudden liberation of the gas would be that nearly the whole weight of the inner lift would, by reason of the obliquity of the guides, be momentarily thrown upon the roller carriages of the outer lift, and in the same way nearly the full weight of both lifts would momentarily be thrown upon the roller carriages on the edge of the tank. This, coupled with the subsequent jarring effect of the rapidly falling lifts as they acquired momentum, might conceivably give the necessary shock to bring about the instant failure of a structure constructed of brittle steel, in which there may have already existed a high initial stress, or which possibly had been weakened by former repeated severe applications of load.

As to the manner in which the gas became ignited, the suggestion that it was lighted by the sparking of the metal appears to afford the most reasonable explanation of the occurrence; and I am inclined to agree with Mr. Doig Gibb that the probabilities are against its having been ignited by a light at any distance from the holder. It is evident that ignition must have occurred very quickly, because flames were the first thing seen by most of the eye-witnesses when they heard the rumbling noise, which noise, moreover, was probably caused by the guides sliding quickly through the rollers as the lifts telescoped.

Design of the Tank.—Another reason for my belief that the fracture of the tank was caused by a vertical pressure is that, with the roller carriages bracketed out as they were on the inside to the extent of 24 inches, the tank sides were especially weak to resist such a strain. The portion of the tank side immediately below each of the brackets, under such conditions, would become in fact a very eccentrically loaded column; and when it is considered that the only stiffening provided consisted of a pair of 5 in. by 3 in. by ½ in. angles on the outside extending down two-thirds the depth of the tank, and that in the case of a tank 115 feet in diameter very little assistance against buckling would be given by the horizontal curvature, the weakness of the tank in this respect must, I think, be admitted.

If the third lift* had been provided at once, the projection of the rollers would only have amounted to about 9 inches, and the sideways pressure on the tank side would have been comparatively slight. But to overhang the rollers to the extent of 24 inches without materially adding to the vertical stiffness of the plates below introduced, in my opinion, a distinct element of weakness, since at such a leverage the bending movement on the side of the tank would add considerably to the horizontal stress already in the plates from the water pressure. Moreover, the effect of the vertical compressive stress and the horizontal tensile stress would be to set up considerable stress on planes at an angle of 45° with the vertical, and would have to be taken into account.

The maximum deflection, treating the side of the tank as a thin column, would occur at about the third tier down; and consequently the intensity of the stress on the plates would reach a maximum also at this depth. Moreover, a sudden load so applied would partake of the nature of a shock; and this, as I have already mentioned, is what I am inclined to think actually occurred.

Not only does this view coincide with the evidence given by the witness who saw the water spurting out at about this level, but it finds a certain amount of corroboration in a photograph of the fractured end of the tank side in which the plating of the third tier and the vertical angle-irons are indicated as having broken very much as one would expect in circumstances such as I have described.† A fracture having once occurred in this way, the rent would immediately extend; and in the case under consideration, it seems to have done so instantly, both upwards and downwards, until it completely severed the side of the tank.

Dealing with figures, and assuming 27 tons to have been the ultimate breaking stress of the steel, if we neglect the value of the skin plating, which has its own work to do in resisting the static pressure of the water, the ultimate value of the moment of resistance of the two 5 in. by 3 in. by ½ in. angles against deflection as a column would only amount to about 155 inch-tons—a bending moment which would be given by a load of about 6½ tons on one roller carriage. Even if, in addition to the two angles, we assume that the whole 18 feet bay of plate is an effective column, which is an absurdly extravagant assumption, we should only raise our breaking load on the bracket to 10 tons; and the yield-point of the material would be reached with about two-thirds of the above loading. That a load of this intensity could easily be concentrated on a single bracket can be realized when it is considered that the weight of the two lifts distributed over the twenty brackets will give an average of 6¾ tons per bracket, supposing all the rollers to be in perfect adjustment, which, of course, would not be the case.

I am unable to agree with the theory put forward by some of the expert witnesses that the fracture commenced at the top edge of the tank, because I do not see how such a pressure could have been concentrated on one point as to start a tear through an angle-iron curb 5 in. by 3 in. by ½ in., to say nothing of the tank skin and platform plating. To shear through, or pull apart, a curb of these dimensions would require a load of something like 80 or 90 tons; and, in my opinion, long before such a load could have been brought to bear upon it, a comparatively flimsy structure like the lift of a gasholder would have crumpled up and have ceased to be dangerous.

The question then arises: How was it the top curb was severed? To my mind, this is accounted for in the following manner: As soon as the tank skin tore, the total tangential bursting pressure it was intended to resist would, for quite an appreciable period of time, be transferred to the top and bottom edges of the tank. This total tangential pressure would amount to about 540 tons, and of this one-third, or about 180 tons, would come upon the top edge. The only really effective part of the top edge to resist this force was the 5 in. by 3 in. by ½ in. angle-iron curb which was riveted to the skin plate, and could be torn asunder by a pull of about 95 tons; for the attachment to this curb of the chequered platform plate and its outer angle was not such as to give it any immediate assistance. It would, therefore, not be until after the main curb had parted that the full tension of 180 tons would fall upon the platform; and since the latter, with its outer angle, was no more capable than the main curb of resisting such a pull, the complete severance of the tank side ensued.

Conclusions and Recommendations.

Though it has not been possible to say definitely how and in what manner the accident at Ilkeston occurred, I think the facts disclosed by the inquiry show that it is by no means unaccounted for, and that had the tank not been structurally weak the result of such an occurrence as the temporary jamming of the holder, or the unsealing of a lift, would probably have been confined to loss of gas and damage to the holder itself.

As regards the employment of steel tanks above ground for gasholders, even of the spiral-guided type, nothing I have seen or heard leads me to condemn their use, provided they are properly designed, constructed, and maintained. But in such structures nothing should be left to chance, and adequate provision should be made not only for meeting all the ordinary working conditions, but also such contingencies as the jamming or premature telescoping of lifts, which, though uncommon, experience has shown are liable to occur, and must not be ignored.

As events have proved, the Town Council were somewhat ill-advised in not calling in a specially skilled engineer to assist them in the choice of a design; and the initial mistake made was the acceptance, without question, of a specification and design from a manufacturer in competition with other firms. This is a practice which has come increasingly into vogue during recent years; and it cannot be too strongly deprecated. There is nothing to be said against, and in fact a great deal is to be said in favour of, inviting firms who make a speciality in the manufacture of a certain commodity to submit prices and their own designs. But in such cases the customer should certainly specify, among his other requirements, what material is to be used, the tests to which it is to be subjected, and the limiting working stress or factor of safety to be employed. When the designs are sent in, they should also be carefully examined, and calculations checked, to see that they comply in all respects with the specification and requirements laid down. And, moreover, as emphasized in the case now under consideration, it is most important and necessary that independent tests should be made, on behalf of the customer,

* The tank was constructed large enough to allow of the addition of a third lift when required.—Ed. J.G.L.

† The photograph accompanies the report. It is similar to the first illustration on p. 144 of the "Journal" for Jan. 16, 1912.—Ed. J.G.L.

of the plates and bars before work is commenced upon them. This is the invariable practice with consulting engineers of standing and repute; and in important works it should never be omitted. It is too often the case, however, that public and other bodies, with a mistaken idea of economy, elect to dispense with the services of a qualified adviser because, not only do they grudge his fee, but they fear that, as a result of such action, they might be compelled, against their inclinations, to adopt more substantial and costly works. But there is little room for doubt that in the long run, and in the interests of all concerned, it is the best and cheapest policy; and it has been amply exemplified in the present instance.

The other lessons to be learnt from the Ilkeston disaster, and the points which I would submit for serious consideration by both the engineers and the manufacturers concerned in the erection of steel gasholder tanks, are embodied in the following recommendations:—

(1) *Material.*—That the use of basic Bessemer steel for such important structures should be avoided, and that the British Standard Specification for structural steel for bridges and general building construction should be universally adopted.

(2) *Factor of Safety.*—That in such cases there should be provided a factor of safety of at least 4—that is to say, the maximum working stress on the material, ascertainable by calculation, should not exceed one-fourth its ultimate breaking stress. In special circumstances, such as proximity to dwellings or in exposed situations, it might possibly be advisable to employ a factor in excess of 4. It certainly ought in no circumstances to be allowed to fall below this figure. In the case of a tank for a spiral-guided holder which has to take up and resist stresses due to wind and irregularities in working, the exact intensity of which it may be difficult to estimate, a more generous factor should be allowed than in a tank for a standard holder, which, in the main, is subjected only to the static pressure of the water.

(3) *Design.*—(*a*) It is essential, in all tanks for spiral-guided holders, that an efficient pillar or strut should be introduced on the outside of the tank at each end of the load points, for the purpose of relieving the side of the tank of all vertical pressure. These struts should be stiff enough to resist the bending moment induced by an eccentrically applied load; and this provision becomes of special importance in a tank constructed for the future addition of another lift, where, owing to the necessarily increased overhang of the roller carriages, the eccentricity of the load is augmented, and becomes an important factor to be taken into account. (*b*) That in tanks of any size or importance, all holes in steel plates or bars exceeding ½ or ⅝ inch in thickness should be either drilled or punched and reamered, and not punched the full size. It is hardly necessary to add that the strength of all joints and connections represents the net strength of the plates and bars, and should be designed accordingly.

The report is followed by three appendices.

Appendix A.

Tests Supplied to Messrs. C. & W. Walker, Limited, by Rolling Mills, of Bessemer Basic Steel Plates Used in the Construction of the Ilkeston Gasholder.

Cast No.	Dimensions of Piece. Size.	—	Area.	Ultimate Stress. Total.	Tons per Square Inch.	Elongation on 8 Inches.	Carbon.	Manganese.	Sulphur.	Phosphorus.
						Per Cent.				
62	1·50	·55	·825	22·6	27·3	27	·116	·70	·05	·07
131	,,	·56	·840	23·2	27·6	25	·119	·69	·05	·06
58	,,	·50	·750	20·6	27·4	27	·117	·70	06	·07
49	,,	·43	·645	18·2	28·2	25	·119	·68	·07	·06
32	,,	·31	·465	12·9	27·7	24	·118	·69	·07	·06
102	,,	·25	·375	10·3	27·4	25 5	·115	·72	·05	07
111	,,	,,	,,	10·4	27·7	23·5	·119	·68	·05	·06
114	,,	,,	,,	10·6	28·1	23·0	·120	·67	·05	·06
182	,,	,,	,,	10·7	28·5	23·5	·118	·69	·07	·07
67	,,	,,	,,	10·2	27·2	26·0	·118	·68	·07	·06

Appendix B.

Mechanical Tests made for Mr. J. Ferguson Bell at the Testing Department of the Midland Railway Company, Derby.

—	Specimens Cut from ⅝-Inch Plate near End which Fractured. With the Grain.		Across the Grain.	
Test number	63,341	63,342	63,345	63,346
Breaking stress in tons per sq. in.	27·4	27·6	26·8	27·3
Elongation on 8 inches, per cent.	25·0	23·5	24·8	24·5

—	Specimens Cut from Same Plate at End Opposite Fracture. With the Grain.		Across the Grain.	
Test number	63,343	63,344	63,347	63,348
Breaking stress in tons per sq. in.	35·4	25·4	25·6	25·6
Elongation on 8 inches, per cent.	29·2	29·2	30·0	29·2

Specimen ⅝-inch plate, side of tank adjacent to where it ripped: Breaking stress per square inch, 27 4 tons; elongation on 8 inches not given.

Mechanical Tests made for Mr. Samuel Glover at the Whitworth Engineering Laboratory, Manchester.

	Specimens from ⅝-Inch Plate.	Specimen from ⅝-Inch Plate.
Marks on specimen	1	G.I.
Breaking stress in tons per square inch	27·1	28·6
Yield-point	18·8	21·7
Elongation on 8 inches, per cent.	26·2	24·9

Analysis of Drillings taken from the Ilkeston Gasholder Tank Plates, made by Mr. L. Archbutt, F.I.C., F.C.S., Chief Chemist to the Midland Railway Company, Derby.

—	Drillings or Slottings taken from ⅝-Inch Plate. Close to Fracture.	Close to Fracture.	From Opposite End of Plate.	Drillings taken from Piece of ⅝-Inch Plate.
Test number	..	63,341	63,343	..
Carbon p.ct.	·052	·065	·060	·065
Silicon ,,	·007	·002	·002	·007
Manganese ,,	·553	·545	·575	·562
Sulphur ,,	·030	·050	·035	·056
Phosphorus ,,	066	·100	·078	·096

Drillings taken close to fracture—

Test office number, 63,489; phosphorus, ·098.

Drillings from opposite end of plate—

Test office number, 63,497; phosphorus, ·076.

Drillings taken about 1 foot apart from top to bottom of fractured plate at fractured end—

Test office number	63,568	63,567	63,566	63,565	63,564
Sulphur per cent.	·030	·049	·047	·047	·027
Phosphorus ,, ,,	·067	·102	·101	·102	·066

Drillings taken in corresponding positions from opposite end of plate—

Test office number	63,632	63,631	63,630	63,629	63,628
Sulphur per cent.	·032	·036	·034	·032	·028
Phosphorus ,, ,,	·071	·079	·076	·073	·068

A comparison of these figures with the results given by tests at rolling mills of steel plates indicates considerable variation. The bottom side plate that ripped is segregated; towards the centre of the plate the phosphorus present is unduly high, with the result that this plate is brittle.

Analysis made for Messrs. C. & W. Walker by Messrs. Pattinson and Stead, of Middlesbrough, of a Sample of Steel Plate.

Carbon (by combustion)	0·090 per cent.
Manganese	0·679 ,,
Sulphur	0·071 ,,
Phosphorus	0·078 ,,

Appendix C.

Mechanical Tests made for Mr. A. G. Drury at the Testing Works of Mr. A. H. H. Stanger, Westminster.

—	Specimens Cut from Piece of ⅝ Inch Plate which Fractured. With the Grain.		Across the Grain.	
Test number	37,344	37,348	37,346	37,350
Breaking stress per sq. in. in tons	23·71	28·64	18·64*	26·49
Yield-point ,, ,, ,,	15·07	18·84	..	18·09
Elongation on 8 inches, per cent.	26·00	26·50	..	17·00†

* Broke through flaw outside datum-point. † Full extension not measurable as piece broke close to datum-point.

Four specimens, two with and two across the grain, were also bent flat upon themselves without showing any signs of cracks; and two specimens, cut at an angle of 45° to the direction of rolling, also satisfactorily withstood bending tests.

Mr. Stanger also made a microscopical examination of two plates—one cut from the tank plate adjoining the fractured one; the other from the tank plate which fractured. He gives three micrographs showing the character of the surface and a cross section of plate No. 1, and a longitudinal section of No. 2. In his report, he says the former showed at the edges a large, bright crystalline structure, and it was also badly cracked in several places. The latter showed at the edges a slightly crystalline structure, and was free from cracks. The crystalline grains shown in plate No. 1 were very large, and near the surface of the plate were nearly free from carbon. The structure of No. 2 was of much smaller grain, and was of a normal steel well annealed.

Mr. Stanger makes the following remarks: "As the microscopic structure of a steel is largely due to the heat treatment the metal has received, it is obvious that the two plates must have been very differently treated. When a plate is subjected to heat during the process of annealing, the crystalline grains increase in size, and within certain limits a ductile, and therefore less brittle, metal is obtained. When, however, the heating is prolonged unduly, the crystalline grains increase in size to such an extent that the metal as a whole is rendered brittle. This appears to have taken place in Plate No. 1. The crystalline grains are abnormally large; and the metal at the surface of the plate is nearly free from carbon. I am of opinion judging from the whole of the facts before me, that the plate marked No. 1 has been excessively annealed, with the result that the metal has become partially decarburized, and a granular structure developed of abnormal size."

THE HUMPHREY GAS-PUMPS AT CHINGFORD.

Visit of Engineers.

On Monday of last week a large number of engineers were the guests at Chingford of the Pump and Power Company—the owners of the patents for the Humphrey gas-pump, which was described and illustrated last week, pp. 757-61. A special train was run from Liverpool Street Station to Enfield Lock Station, where the party was met by large brakes, and conveyed to the works of the Metropolitan Water Board. The weather was a curious fight for supremacy between sunshine and snow; but on the whole the sun prevailed, and the weather was bright, though far too cold to be ideal for inspecting outdoor works.

The proceedings commenced with a reception by the Chairman and Directors of the Pump and Power Company.

After this the party moved off to the stands erected at the water outlets of the Humphrey pumps, which pour such huge volumes of water into the new reservoir. The latter needs no further mention now, especially in view of the publicity given by all the Daily Press in connection with the recent visit of the King and Queen. The wonderful working of the pumps was fully demonstrated to the engineers present. After separate trial runs with each of the pumps, there was a slight delay, as the tidal conditions of the river were not quite favourable. Then, at a given signal from Mrs. Humphrey (wife of the inventor), three of the pumps were turned on at once; and it was a fine sight to see the huge volumes of water dashing down the steps—especially when the other two pumps were started. The next demonstration was extremely interesting. An electric bell, connecting the pump-house with the stands, was rung from the latter by one of the guests. At this signal, one man proceeded to turn on successively three of the pumps. Times were taken from the stands, and within seven seconds of the ringing of the bell the first pump was delivering water, two pumps within one minute, and all three within one minute fifty-three seconds—really remarkably quick work. Mr. Humphrey announced these times later, adding that they were taken by an independent witness.

An adjournment was next made to the marquee, a welcome refuge from the bleak wind outside, and tea was served. In the course of this, silence was called for, and Mr. Leslie Robertson, in the name of the Pump and Power Company, thanked Mr. W. B. Bryan, the Chief Engineer of the Metropolitan Water Board, for his presence among them that afternoon, and for his kindness, courtesy, and help to the Company during the negotiations for, and the erecting of the plant. Mr. Bryan, replying, thanked Mr. Robertson for his kind words, and the guests for the way in which they had received them. No doubt they had all been impressed by the fine sight they had seen; and the Pump and Power Company were no doubt proud of their work. But they must not forget the tests had not yet been made! [Laughter]. He spoke of the various schemes that the Board had had to consider, saying that they had selected this one because they thought they could get more for their money from it than from any other. Up to the present it was a magnificent success, and he had no doubt its triumph would come when the tests were made. He regretted having no time to say anything more, as he had to leave to catch a train to Manchester that afternoon. Mr. Bryan was loudly cheered, and then Sir Alfred Ewing thanked the Pump and Power Company on behalf of all those present for their kindness and hospitality, and for the excellent arrangements made for the inspection that afternoon. He admired the tremendous pluck of the Company in daring to undertake such a scheme on a scale many times larger than anything that had been attempted before. The invention, he said, would appeal to Englishmen, as being essentially English; but he had no doubt whatever that its unqualified success would lead to its extensive adoption abroad. After a reply by Mr. Emile Mond, the Chairman of the Company, the guests were addressed by Mr. Humphrey, who was loudly cheered. He announced the times taken in the experiment described above. Passing on, he said there were three names he must mention—names of men to whom he owed a great debt of gratitude, to whom was really due a large share of any success he had achieved up to the present. The first was the late Dr. Ludwig Mond; the second was Mr. Rusdell, who had been of such extreme assistance in carrying out experiments while he (the speaker) had been engaged with patent formalities and other work; the third was Mr. Bryan, to whose daring it was, after all, largely due, that this chance had been given to the pumps. He remarked that they already had a pump working with 10 feet suction lift without any special arrangements being made. With special arrangements, they could get 18 feet suction and a 300-feet lift. In Germany they were already working with liquid paraffin, which no doubt was the beginning of still further extensions.

After this, the party moved off to inspect the pump-house and the producer plant. These need no further description in our columns. The pumps, which were all working, appeared simple enough to control, and certainly do give the impression of the mighty power they possess. With this, the proceedings closed. The guests were conveyed back by the brakes to the station and the special train; and a most interesting and enjoyable afternoon was thus brought to a conclusion.

RELATIVE VALUE OF COAL TAR AND NATURAL BITUMEN IN ROAD CONSTRUCTION.

An interim report issued by the Road Board last January gives some interesting particulars on the behaviour of the trial-lengths of road surface which were laid down in July, 1911, on the main road from London to Maidstone and Folkestone, between New Eltham and Sidcup. The trial-lengths were put down with the object of obtaining a record of comparative results in a better and more reliable manner than is generally obtainable in the case of road surfaces laid down in the ordinary course of road maintenance in different parts of the country.

There were in all twenty-three trial-lengths, each about 110 yards in length, and each laid with different material or in a different manner. The interim report gives the results of observations on each section, and the extent of repairs and scavenging necessary, up to November last. Thus the behaviour of the trial-lengths for a period of about seventeen months has been officially noted. It is worth while studying the report in order to see how the trial-lengths, in which coal tar or coal-tar pitch has been used, have behaved in comparison with those in which either natural bitumen (asphalte) or no bituminous material has been employed. It should be remarked, however, that the report points out that the traffic on the road selected is much heavier, both as regards its kind and its quantity, than most roads have to carry; and the trials therefore provide an unusually severe test.

The descriptions of the methods and materials of construction of the trial-lengths show that on three sections no, or very little, bituminous material was used, on nine sections asphalte or some natural bituminous material was used, and on eleven sections coal tar or coal-tar pitch was employed. Of all these sections, eleven were reported as good in November, 1912. Of the eleven, one—*i.e.*, granite cubes, grouted, however, with a mixture of coal-tar pitch, tempered with creosote oil or tar, and sand—can scarcely be classed as essentially bituminous, three contain asphalte or natural bitumen, and seven coal tar or coal-tar pitch. Thus, after seventeen months' wear, one-third of the non-bituminous sections are good; one-third with natural bitumen are good; while seven-elevenths of the coal-tar sections are good. This is an almost surprisingly good showing for coal tar, especially when it is remembered that asphaltic preparations are generally handled only by firms having long and varied experience in road-surfacing work, whereas the use of coal-tar preparations for such work was, in June, 1911, comparatively new. Many sections were, doubtless, laid with coal tar and pitch without the guidance of ripe experience. Only one of the eleven coal-tar sections had been relaid up to November last; whereas two of the nine asphaltic sections had been re-laid and one of the non-bituminous sections. The latter was simple water-bound granite macadam, laid merely for comparison purposes.

The average cost per superficial yard of the tar and pitch sections was 4s. 0⅛d.; that of the asphaltic sections, 5s. 2d.; and that of the non-bituminous sections, 4s. 4½d. Thus, in respect of durability and initial cost, coal tar and pitch compare very favourably with other materials for road construction. If this is the case on a road where the traffic is heavier than most roads have to carry, it may be surmised that for the generality of main and secondary roads throughout the country, there can be no cheaper and better mode of surfacing than some form of tarred or pitch-bound macadam. The nature of the traffic which passes over the trial sections may be gauged from the fact that, in August last, the number of motor-omnibuses averaged 331 per diem, and the total number of motor vehicles and trailers 638 per diem. The horse-drawn vehicles averaged 387 per diem, and cycles 750. These statistics show that the trial sections have been pretty thoroughly tested; and it is gratifying to note how well coal tar and pitch have behaved in such severe conditions.

An "Unsolicited Testimonial" for the Electric Light.

A correspondent forwards a circular issued by a well-known firm of manufacturing opticians, advertising their "Solar" lenses. In it, this paragraph appears: "For workers under electric light, they are also specially recommended; and it will be found that the hot, tired sensation experienced after a few hours' work is no longer manifest if 'Solar' lenses are worn."

HIGH-PRESSURE GAS DISTRIBUTION.

By N. B. Hodgkin, of Birmingham.

[A Paper read before the Midland Junior Gas Association, March 15.]

(*Concluded from p. 769.*)

It was stated last week that the portion of Mr. Hodgkin's paper which was arranged for publication had been divided into two parts. The second part, and a report of the discussion that took place at the meeting of the Association, are given now.

General Lighting.

The section dealing with general lighting the author commenced by dealing with the Keith and "B. and C." systems of lighting and compression. He then proceeded:

Assuming the position of the compressor or meter has been decided upon, ascertain the points and their disposition. By "points" I mean the different supplies for lamps, pendants, brackets, &c. Decide as to the size tubing necessary. Always have an eye to future requirements. Take careful note of the fittings in the pipe run. Plan the run of pipes. Picture in your mind's eye the work as it should be when finished. By so doing, you often avoid pitfalls. Have riders connecting long parallel runs. Avoid cutting through; work round if possible.

Single-ring brick and stone arches must be avoided. They carry great weight as a rule; and by cutting through, the setting is damaged, and the superstructure imperilled. The damage may not manifest itself for two or three years. Run all high-pressure pipes on the face, painted a distinctive colour. In all syphons, screw the high-pressure cock into the tee, then the tubing; syphons may thus be emptied at any time. Do not forget to have plenty of tees, plugs, and connectors with back-nuts, as they are very useful things to have in an installation. Have all work executed in the best possible manner, as installations completed and giving satisfactory results are advertisements, and excellent ones, to the industry.

In general work, unfortunately, we have to approximate the amount of illumination required; so that it becomes necessary to collaborate our practical with our theoretical knowledge—in other words, combine practice and theory in relation to the local conditions with which we may be dealing. For example, shop windows are dressed often and differently. When the order is taken, light material may be in one window and dark in the next, and *vice versâ* a few days later. In workshops, too, the materials worked up on one particular lathe may vary from time to time. Again, in parade lighting, abnormal conditions may obtain more frequently in one place than in another. Embodying the conditions for all purposes we may well consider them from three standpoints: (1) Ophthalmic, (2) hygienic, (3) economic.

(1) and (2).—We must give the necessary amount of light in such a manner that it will not be a source of discomfort or fatigue to the occupants of any place or premises we may fit up. Suitable illumination is of paramount importance to the industry at the present time. Systems of lighting which fatigue the eye, and thus the body, should be condemned and avoided. All light should have a preponderating downward tendency, uniformly diffused, excluding all direct light rays from the line of vision.

For internal and office lighting, it is good practice to have a special dish attached to the pendant directly underneath the globe, either of diffusing opal or malt or milk glass—these diffusing a uniform brightness over their visual area, thus giving an artistic effect which is pleasing and graceful. Additionally, there are light rays reflected to the ceilings and side walls. One fact must always be borne in mind—viz., if architecture has any power to charm, this power can only take effect when it is subjected to suitable illumination. With internal shop lighting, the systems of ventilation must be of the best, especially with indirect lighting.

The outside lighting of shops must be approached with care. It is not essential, in my opinion, to create a glare on the front, and to so arrange the light that it obtrudes the vision of a would-be customer and causes him to pass along. Be guided by past experience. Light the window or windows in such a manner that every article is seen clearly, whether it be light or dark in colour and texture, and see that the rays of light are not a source of discomfort or fatigue to the vision of people standing close to the window. Parabolic reflectors add greatly to the light thrown into the window, and prevent the light rays creating a glare. Deck lighting, of course, is the ideal way to light up a window; but it is possible and safe in very few places.

(3) The question of economy arises with every installation; and the various costs must be given impartially. The capital cost is not, as a rule, the deciding factor. Maintenance charges and depreciation are the chief consideration, and for this reason should be worked out very carefully. Particular attention must be paid, when the work is in hand, that every one of the different sizes of lamps utilized is suitable for its special purpose.

In Birmingham, at the present time, we have a large number of 1000-candle power high-pressure lamps on hire, at a rental of £5 per annum. This charge includes gas maintenance and labour. In isolated cases, where the shop or building is situated in a very dark place, the gas is paid for at a schedule rate. In all instances the lighting and extinguishing are under the control of the consumer. The supplies are laid by the Gas Department staff free of charge. All pipes are fixed on the face, in full view, and outside the premises, as far as possible. Safety-clips are attached above and below the ball-joints; and all the joints on the lamp arm are pinned together.

For street lighting, we have an excellent example in Victoria Square and Paradise Street. There are 31 lamps in all, of the Ehrich and Graetz type, 30 of which give a light equal to 4000 candles, and are capable of illuminating a space 100 yards square. The lamps are fixed to ornamental standards; the mantles being about 20 feet clear of the ground. With eleven of the lamps, three control cocks are fixed at the base of the column, and copper supplies are taken up, terminating at the top of the lamps with spiral coils, and connecting with union joints. Supply No. 1 conveys high-pressure gas to two burners; supply No. 2, to one burner; and supply No. 3 conveys high-pressure gas to the bye-pass, the pressure being reduced by means of a special cock. The remaining twenty lamps are controlled and fed from the Council House; one 2-inch main supply pipe conveying high-pressure gas at $5\frac{1}{2}$ inches mercury pressure to one burner only in each of the lamps, and a 3-inch pipe leading to the remaining two burners in each lamp. The bye-passes are fed from the low-pressure main.

At the Council House, the mains are bye-passed, and two control cocks fixed, one to each of the two mains. At stated times, the 3-inch valve is turned off, leaving one burner only alight during the early morning hours. The usual gauges and testing apparatus are fixed for testing purposes.

There are a large number of anti-vibrating devices upon the market; and one that is advocated rather freely, with a spiral spring interposed between two brass joints, which are in turn connected by flexible tubes, is to my mind wrong. It is well known how difficult it is to effectively calibrate a spring to constantly take up an exact strain in connection with flexible tubes—the spring being either too weak or too strong. A much better device is one in which a coil of solid drawn copper with three turns is employed; a guiding stay being attached directly from the lower portion of the pendant to the top. The copper, besides serving the purpose of an anti-vibrator, acts as a supply-pipe.

When giving estimates and specifications, it is necessary to be extremely careful in all statements concerning candle power. In the earlier days of the introduction of high-pressure lighting, many difficulties arose and were accentuated by those responsible for the sale of high-pressure apparatus. The difficulties were created by the manufacturers, who made such excessive claims as to the efficiencies obtainable by high-pressure gas. Elaborate curves were given; but they were procured under special circumstances, which would not be met in practice. The decision of the public is the main factor; and one repeat order is of more value than the most elaborate photometric test. Actual working results should be the basis of all estimates and specifications.

The efficiencies of some high-pressure lamps are given, not in English, but Hefner candles, on the same basis as electrically worked lamps. This is a matter to be brought before the notice of the consumer. The German standard is 10 per cent. less. Again, a 1000-candle power lamp, is based, or should be based, upon a maximum efficiency of so many candles per cubic foot per hour, in a laboratory without glass. It is necessary to allow 10 per cent. from laboratory tests for the absence of glass, or of exceptionally thin and brilliantly clean glass, used in making the test. Again, this does not obtain in ordinary lighting, where the light is actually used. Also 10 per cent. must be allowed for variability in quoting on mantles, &c.

With electricity, constant voltage is the main factor for efficiency; with high-pressure gas there are several factors to be considered, each having a tendency to take off a certain percentage of the actual light emitted—viz., thicker glass, imperfect aëration, lower mantle power, differential calorific values of the gas, condition of the reflectors, differential pressures, cleanliness of the burner, &c. Each separately, in effect, may mean a difference up to 25 per cent. in the candle power.

High-Pressure Gas for Industrial Purposes.

Under this heading I purpose dealing (1) with a complete installation in actual practice, one similar to which could be utilized for the melting of nearly all metals used for industrial purposes, by the simple duplication of the furnace construction—all furnaces are constructed according to the requirements of the metals to be melted; and (2) with a few of the industrial appliances and apparatus in more general use, and the chief points in connection with same.

The following installation was fixed provisionally, and as an experiment. It was necessary to supply high-pressure gas at 12 lbs. pressure to one 500 lbs. solid furnace and one tilting furnace. The furnaces were erected to designs supplied by the

High-Pressure Laboratory. The solid furnace was part of a battery of twelve. By the fixing of a compressor, it saved laying the high-pressure main a distance of 1¼ miles, though, in the near future, as the experiments made have been successful, and the working costs so small, it will be necessary to give a direct supply from the main. A detailed description will be of interest, as there are several points to be noted, from the meter to the tilting furnace—the "Alpha and Omega" of the installation as it were—that may be of some value to members in like circumstances.

A 6-inch low-pressure service was laid, to enable a larger supply to be obtained, without having to open up the ground, if further experiments than those contemplated at the time were found necessary, before the laying of the high-pressure main; and I may state that we are about to carry out a series of further experiments. A wet cylindrical meter was fixed. An outlet main of 6-inch wrought-steam tube was laid direct to the conduit running in front of the furnaces. Two 6-inch tees, with 3-inch centres, were fixed *en route* for connection to the inlet and outlet of the compressor. Interposing the two tees were two 12 in. by 6 in. flanges. Again interposing these two flanges was a circular flange of sheet steel. Thus on one side of the 6-inch main was low-pressure gas, and on the other was the compressed gas. The idea was that by taking out the steel blank flange, and substituting a washer, the long run of 6-inch tube could be made into a continuous high-pressure main with little trouble, when necessary.

The Worthington compressor will deliver 1200 cubic feet of compressed gas at 13 lbs. per square inch per hour, running at 400 revolutions per minute. The compressor is designed for air, but answers equally as well for gas compression. It is a single-acting, high-speed machine—that is, compressing gas on the up-stroke only.

The unloader cuts off the supply on the suction side, when the pressure upon the receiver rises above a predetermined figure. The compressor then runs with a friction load only; a vacuum being produced in the cylinder on the suction stroke. Owing to the amount of sand and fine dust in the casting shops, there was a possibility of the unloading device becoming clogged; and to prevent any mishap a bye-pass valve was fixed as shown—the spring being calibrated to unload at 14 lbs. pressure.

Notwithstanding the long run of 6-inch tube, and the small amount of gas required per revolution of the compressor, the volume of gas in the pipes was insufficient to take up the oscillation. Consequently, a gas-bag was fixed, to prevent damage to the meter, and possibly inaccurate registration. The receiver serves the double purpose of preventing pulsations on the high-pressure supply and the gasholder. There is a ¾-inch pipe connected to the safety-valve, and a ⅜-inch pipe to the unloader. A pressure-gauge is fitted at the top of the receiver, and a tap for drawing-off products of condensation at the base. It is important that the beds for the compressor and receiver be both solid and free from vibration.

The 6-inch wrought-iron pipe was continued to the pit running

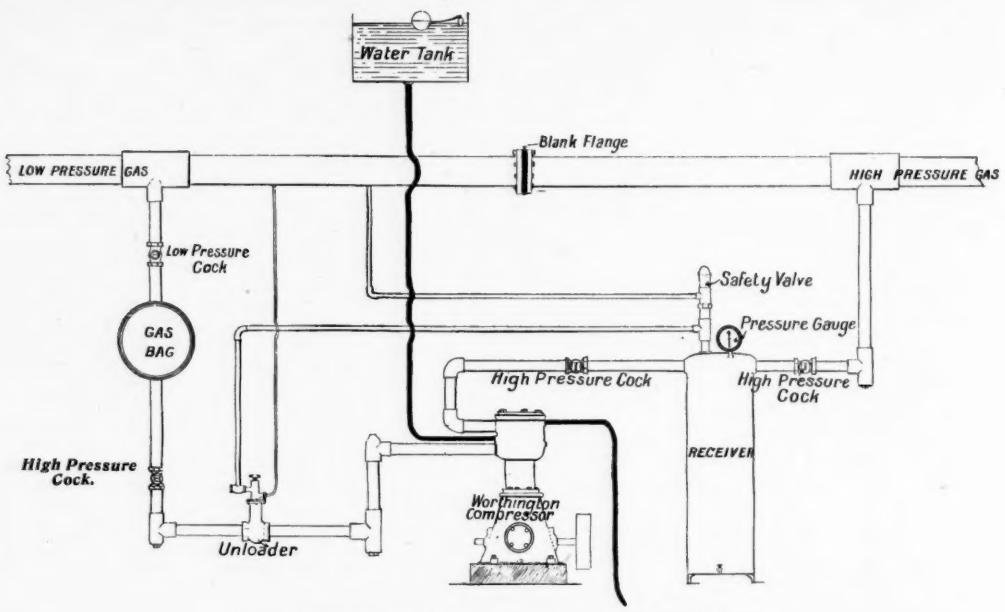


DIAGRAM SHOWING THE COMPRESSOR AND THE CONNECTIONS.

in front of a battery of twelve furnaces. In the pit special castings were fixed on iron brackets firmly cemented to the wall opposite, and parallel to, the furnaces. Thirteen castings in all were fixed, one for each of the twelve furnaces, and the remaining one to supply a tilting furnace on the ground level.

As two only of the coke-fired furnaces had to be converted, the ¾-inch holes in the 3-inch castings were plugged off, extending from the 3-inch castings, with ¾-inch steam tubes to each of the two furnaces converted, and strapping the supplies with bar iron, pins and nuts securely to the girders carrying the grating.

The cast body of the furnace was next drilled and tapped, and half-clips attached, protruding 18 inches from the furnace, and 15 inches from the patent adjustable injector. The supply was then fixed; tees being left with cocks and elbows looking outwards. Elbows and unions were next screwed on; the elbows looking directly to the injector, and to them were attached spiral coils of solid drawn ¼-inch copper tubes, having three turns in each coil. The object of the spiral copper coil is to allow of adjustment when necessary to the injector tubes of the burners. By using copper instead of flexible tube, there is less likelihood of leakage at the joints, and the tube lasts very much longer.

The tilting furnace had a steam tubing of 1¼-inch bore laid from the last casting; a special conduit being constructed for its reception. The tube was carried up, and securely strapped to the frame carrying the furnace. From this tube, a flexible connection was carried to the back of the furnace (to allow a free movement to the furnace when being tilted for pouring purposes), and then connected to an iron tube securely strapped to the body of the furnace, extending to a point level with the injectors on either side—a tee being left opposite each injector, and high-pressure cocks being attached, screwed into which were elbows and spiral coils of solid drawn copper, ¼ inch diameter. In this case, four turns were made in the copper, but smaller.

All furnaces should have detachable bottoms. If the rib of the casting is made deep, four slots can be drilled, two on either side of a removable cast-iron flanging plate. Into these slots, two bars or keys can be inserted to hold the plate in position. Then, in the event of a broken pot, by knocking out the keys the metal may be cleared, and the interior of the furnace cleaned. It is better to have loose keys than bolts, as it is always a difficult matter, especially in a battery of furnaces, to unscrew the bolts.

Working Costs.

A few figures dealing with the working costs may be of value. It must be understood that standard pots only are given. For instance, a 1000-lb. pot holds about 320 lbs. of aluminium, but is taken on the basis of the amount of cupro it would hold.

	500-lb. Pots.	1000-lb. Pots.
First heat, approximate time. .	2 hours	.. 2 hours
Subsequent heats	¾ ,,	.. 1 to 1¼ ,,
Quantity of gas used	650 cub. ft.	.. 1000 cub. ft.
Pressure	12 lbs.	.. 12 lbs.

60/40 brass melted in 60-lb. pots usually takes from 50 to 60 minutes after the first heat, and costs 5½d. to 8½d. per cwt.—7½d. being a reliable figure to take for the average cost of melting such metal on a practical scale. 60/40 brass in 160-lb. pots usually takes one hour, and costs 8d. per cwt. 72/28 metal in 160-lb. pots takes 1¼ hours to melt, and costs 10d. per cwt. Cupro nickel in 90-lb. pots takes about 1½ hours to melt, and costs 1s. 4d. per cwt. Pure nickel is being melted in 60-lb. pots, takes about two hours to melt, and costs 2s. per cwt. These figures include the cost of heating-up the furnace, which usually takes from one-half to three-quarters of an hour. The costs on fuel alone may prove to be slightly higher than those obtained where coke is used as a fuel; but, as will be seen later, any increase in fuel cost is more than compensated by the savings effected in other directions.

The following is a list giving the approximate consumptions of

various sizes of high-pressure gas-furnaces as determined in our high-pressure laboratory:—

Size of Pot.	Metal Melted.	Approximate Gas Consumption. Cubic Feet per Hour.
40-lb.	60/40 brass	220
60-lb.	,, ,,	250
90-lb.	Low cupro-nickel	650
120-lb.	Brass	500
120-lb.	Gunmetal	650
160-lb.	Brass	650
160-lb.	Gunmetal	730
180-lb.	Brass	730
500-lb.	Aluminium	650

The chief advantage of high-pressure gas-heated furnaces lies not so much in the fuel cost as in other directions. From 40 to 45 heats may be obtained from the pots for ordinary 60/40 brass. The time of melting is cut down. The losses of metal during melting amount to a reduction of at least 40 per cent. on those obtained with either coke or oil furnaces. This in itself more than covers any extra cost for fuel. With these furnaces, there is perfect control of temperature and freedom from the necessary attention usually associated with either coke or oil furnaces. The method is clean; and from tests on alloys produced, they are of much greater reliability and have better physical characteristics.

There is no overheating; and the furnaces are so elastic in their manipulation that they may be called upon to satisfy conditions which may obtain in special circumstances which may arise. There are no ashes; and arrangements are made in the furnaces for tapping-off the metal, should a broken pot occur. The furnaces are simple in construction, and can be relined at a low cost in a short time.

Air-Blast Furnaces.

With this system of metal melting, compressed air carries with it low-pressure gas—differing from high-pressure gas furnaces in the respect that they carry forward or induce their current of air in a ratio proportional to the velocity of the gas. With air-blast furnaces, separate pipes are required for the gas and air supplies; the pipes conveying the air being larger in diameter. The air supply is in the ratio of (say) 7 to 1 of gas.

The gas is first brought into intimate contact with the air in a chamber with an inner cylindrical cone; the air passing on the outside of the cone, and the gas inside, and the two gases then mixing at the bottom of the chamber just before the jet. Upon the inlet pipes of the chamber, to both gas and air feeds, are two large quadrant cocks, with graduated scales. By means of the lever, the gas and air quantities may be adjusted to a nicety. By the marks on the scale, the man in charge can regulate the mixture; and, moreover, by constant practice he knows the balance of adjustment that is necessary to procure high and economical efficiencies.

It is apparent at once that the main difficulty will be with the air supplied, and its condition. It is obvious that the air must be as uncontaminated as possible, quite free from dust and particles of dirt, and containing but a small percentage of aqueous vapour. To procure the preceding condition, it is good practice to filter the air. The receiving air pipe for the blower should be fixed some few feet from the ground, and a filter constructed and fixed at the point where air is drawn in.

A filter can be easily made of sheet iron, with slides made of angle iron, and a loose top—the slides fitting firmly in the grooves. The slides should consist of differently gauged gauzes, muslin, and blanket cloth, with a space of ¾-inch between each section. The loose top allows of the slides being readily taken out for cleaning purposes. Another method of filtering, quite as efficient, is by having a trumpet-shaped funnel firmly attached to the pipe; stretched across the aperture being a thickness of blanket cloth and muslin.

All pipes conveying air any distance must be fitted similarly to ordinary gas-fitting work, having a distinct fall to syphons, with draw-off cocks. By so doing, any condensation of aqueous vapour is collected, and can be emptied periodically. If possible, have the fall in the same direction as that in which the air may be travelling. Have as short a pipe-run as possible. An excess of air pressure is to be advocated. Do not have the blower too small, or the working pressure will be found variable. If the air feed can be laid adjacent to the waste products flues, it is an advantage. The air becomes superheated, and the furnaces are thus more economical in the consumption of gas, by the simple utilization of the waste flue heat.

The air pressure is of great importance—the success or failure of the furnace depends upon it. In systems where the velocity of the mixture is low, the flame is developed on the surface of the burner-jet, even after the furnace has become heated on the combustion-surface. Consequently, the flame is in contact with the nozzle, and the heat is gradually absorbed or transferred. Eventually, the nozzle reaches a temperature nearly as hot as the flame, and melts, the holes fill up, and the nozzle is destroyed. With metals such as phosphor bronze, a serious loss may result. Air-blast burners should be either built-in, or be surrounded by a non-conducting clay ring, to prevent radiation to the burner or nozzle—this preventing rapid erosion of the tube.

With large and small furnaces, the flame temperature is the same under similar conditions; but the volume of heat is vastly different. One advantage of the air-blast furnace lies in the fact that low-pressure gas from the town main may be utilized, and a fan connected to existing shafting.

[The author gave, in conclusion, a short *resumé* of the history of high-pressure gas.]

DISCUSSION.

The President (Mr. F. Shewring, of Droitwich) proposed a hearty vote of thanks to Mr. Hodgkin for giving them this exhaustive and carefully prepared paper. High-pressure gas was, he said, a thing which was coming more and more to the front, though, of course, they were not all of them fortunate enough to have an opportunity of distributing it on a big scale, such as they had in Birmingham. The remarks contained in the paper should, however, be of interest to every one, because it seemed probable that, as time went on, they would all have to prepare themselves to deal with high-pressure lighting. It was satisfactory to see Mr. Hodgkin, who was a comparatively new member of the Association, go to the large amount of trouble that he had done in the collection of specimens and the preparation of illustrations, &c., so as to make the paper of the utmost possible practical value. His contribution would, he felt sure, be thoroughly appreciated by the members. The field covered was a very wide one; and, if he might be allowed to say so, he really thought the author had got sufficient matter in the paper to have made two or even three contributions, each quite as interesting as this one. They might then have had an opportunity of going more carefully into the parts dealt with, and of discussing them at greater length. In the course of his remarks, the author had touched upon the facilities offered by steel tubing for easily bending. While this was undoubtedly the case with the smaller sizes of piping, he (the speaker) thought it was somewhat difficult to do with the larger diameters, and they also ran the additional risk of disturbing the wrapping round the pipe. Great care must therefore be given to the re-coating in this case, so as not to leave the metal exposed. The author also rather advocated the coating of the inside of steel tubing; but this he did not quite agree with. He would very much like to hear Mr. Hodgkin's reasons for the view put forward by him. He himself had a little experience two or three years ago with 1½-inch tubing coated on the inside; but fortunately it was only supplying one house and a public lamp at the time. About a month after it was put down, he had complaints that the pressure was very low. They examined the syphon at the end, and found in it a considerable quantity of a black substance, which had melted from the inside of the tube and run to the syphon. They had to use the force-pump, and by this means they were able to clear it—at any rate sufficiently for the supply of gas required for the house and lamp he had mentioned. Mr. Hodgkin stated in his paper that service and outlet pipes underground should be laid in wood troughing. In the course of his own Presidential Address last October, he mentioned that, instead of adopting this course, he had coated the pipes with bitumen solution, wrapped them in jute cloth, and coated them again. His tests with this method had extended over a number of years, and he had not found many defects so far as regarded corrosion of the metal. So long as he obtained the satisfactory results he had done by this means, he should hesitate to go to the expense of putting in wood troughing, as suggested by the author. The Barrett joint shown struck him as being splendid to overcome the difficulty of leakages; but one point suggested itself, which was that it would likely retard somewhat the passage of the gas. Of course, he might be wrong in this. There were many more matters that might be touched upon; but he thought Mr. Hodgkin had included such well-known practice throughout his paper, that the majority of the points they had in any case to agree with. He would like to ask Mr. Smith to say a few words—that gentleman being, in the Midlands at any rate, the pioneer of high-pressure gas.

Mr. E. W. Smith (Birmingham) said he could not claim to be any pioneer or to have had any experience whatever with high-pressure distribution; but there were one or two things in the paper which he would like to touch upon. He also wished to congratulate Mr. Hodgkin on the extent of the matter that he had dealt with, though, candidly speaking, he had expressed the opinion to the author that he thought it would have been much better to have dealt with fewer points and treated the subjects selected in greater detail. But this, of course, was merely a question of opinion. The paper was one of extreme interest; but there were one or two points, especially in connection with the uses of high-pressure gas, that might be amplified here. In the first place, he thought that in Birmingham they would like to have credit for working with pressures for lighting at least up to 7½ inches of mercury. The 4½ inches of mercury mentioned under the heading of governors was given, he believed, as being the maximum pressure; but in Birmingham they found, and he thought most of the makers were finding, that pressures up to 100 inches of water were the best for giving the highest efficiencies in lighting, taken in conjunction with the life of the mantle. Then in connection with the use of creosote in high-pressure gas-mains for protection purposes, he would like to point out that in Birmingham their experience was that within a few yards of the compressors there was no deposit either of water or of oils; and consequently the protection that was asked for was unnecessary. In fact, the mains were so dry that they found that casters' sand was carried for a considerable distance in them, which would have been impossible if they had been in any way damp. With regard to the figures for melting, he wished it to be understood that at the High

Pressure Laboratory they did not think it useful to quote without a considerable amount of qualification figures for the heating of furnaces, or for the melting of metal in furnaces or for annealing. It was dangerous to give such figures without qualification, because they could be altered by anything up to 50 or 60 per cent., according to the conditions under which the furnaces were being run, even at the same temperatures. There was a point which he thought might be brought out, in connection with its effect on the amount of gas passing through the burners. It was mentioned in the paper that there were different factors which tended to vary the efficiency of high-pressure lighting—thicker glass, imperfect aëration, lower mantle power, differential calorific values of the gas, condition of the reflectors, differential pressures, cleanliness of the burner, &c. To these, he would add a very important thing—the specific gravity of the gas, which varied a great deal more than was generally supposed. Especially in lighting, where small variations in the number of B.Th.U.'s put into the mantle meant so much, it seemed to him that specific gravity should be included as one of the factors which would affect efficiencies. Returning to the furnaces, perhaps Mr. Hodgkin, in revising his paper, would see his way to include the cost of the gas in his costs of melting. Otherwise the figures would not help them very much. In Birmingham, he might say, their chief competitor was oil. What he meant was that the competitor which was coming in and was likely to affect high-pressure gas-furnaces was the oil-furnace. They found, however, after long trials, that, taking everything into consideration—including savings in metal, labour costs, life, &c.—high-pressure gas could easily hold its own against oil. Especially was this the case in connection with aluminium melting; and in this direction apparently oil was making most headway. They found in one large aluminium works in Birmingham the losses of metal due to oxidation with the oil-furnaces averaged about 5 per cent., taken over a long period; whereas in a number of similar works in the city, with high-pressure gas-furnaces, the average loss of metal due to the same cause came out at about ½ per cent. This represented a considerable saving for high-pressure gas. Referring to the section of the paper that dealt with air-blast furnaces, he would like to ask the author what type of burner he was alluding to. He spoke of the air supply to the burner being in the ratio of (say) 7 to 1 of gas. It seemed to him that the quantity of oxygen that would be available in the furnace for oxidation would render it an obvious defect to use an air-blast under these conditions. He had much enjoyed listening to Mr. Hodgkin. High-pressure gas was a subject which should be experimented upon and tried a great deal more than it had been; and he believed there was still a wide field before it for industrial purposes. In papers published during the last few weeks, they had had comparisons of heating metals with high-pressure gas, oil, low-pressure gas, air blast, and surface combustion. These figures were undoubtedly very useful, so far as they went; but it was a different thing to quote figures on furnaces operated under working conditions. The figures for the furnaces quoted were figures connected with burners which were undersized. There was one quoted for hardening; but these furnaces were not practical, and should not be quoted against furnaces of a much bigger size. As regards surface combustion furnaces, these would be supplied when asked for, or where they specially suited the conditions that had to be met. Surface combustion had its own corner to fill; but it was not universal in its application. For such purposes as "glory holes," muffles, and brass melting and metal melting generally on a practical scale, he did not think that as good all-round results had as yet been obtained as with high-pressure gas. In fact, in a glass-works where surface combustion was tried, the consumption was considerably greater than was the case with high-pressure gas. However, this was not meant to say that surface combustion was not the thing in its own special corner. It was a great principle, and no doubt could be applied in many cases; but it was not universal, any more than were the other systems.

Mr. R. G. Marsh (Birmingham) said it was stated in the paper that governors might be of two kinds—mercurial or those having leather diaphragms. Was there no other kind of governor that it was possible to use? Then the author remarked that a governor, however well constructed, acted to a certain extent as a check to the free flow of the gas. If a governor did not do this, would it fulfil its purpose? Again, to "govern the velocity, not the volume" was a phrase he did not quite understand. What did Mr. Hodgkin mean by it? Velocity, volume, and pressures of gas were all intimately connected, and it was impossible to change one without affecting the others. In the paragraph relating to the lighting of Victoria Square, 31 lamps in all were mentioned, and it was stated that 30 gave a light equal to 4000 candles. What became of the other one? The next paragraph said that at the Council House the mains were bye-passed; but he thought the author meant that the governor controlling the outlet mains was bye-passed, so that in the event of it going wrong the system could be kept in use without it. Mr. Hodgkin went on to say it was well known how difficult it was to effectively calibrate a spring to take up an exact strain constantly in connection with flexible tubes. In the anti-vibrator devices he (the speaker) had seen, the spring was merely dimensioned to take the weight of the fitting without undue extension. He did not know any effort was made to calibrate it in connection with the tube. The objection that was usually taken to flexible tubes, he thought, was that they were liable to deteriorate in time, and in this way become a source of danger through leaking.

Mr. F. H. Pratt (Long Eaton), referring to the suggested need of a technical research laboratory, said that, of course, every progressive person in the industry to-day recognized that it would be a thing of great value, provided that the industry performed its part at the proper time—that was to say, that the smaller undertakings took advantage of the laboratory by applying for information. Unfortunately, there seemed to be a spirit abroad with certain of the smaller undertakings that such investigation was perhaps not worth troubling about. They were content to leave it to the manufacturers; but this was really not sufficient. In the section dealing with service-pipes, on the point regarding jointing materials, the author said: "It is important to paint the inside of all fittings, as well as male threads on pipes, so that in screwing-up the cement is pushed on into the fitting, and makes a solid wall of cement at the end of the pipe inside the fitting." Personally, as a fitter, he did not quite agree with this. If the jointing material were forced up inside the pipe, forming a ring of cement, the result might be an obstruction of the gas. The material would solidify, and if the pipe was subjected to vibration it would be gradually broken up into dust and carried through with the flow of gas, and so give trouble. The protection of service-pipes was a matter that was, in his opinion, somewhat neglected in certain parts of the country. So far as the southern districts were concerned, some of the companies had not gone to the trouble of providing a trough, or even of pitching or tarring the services. As to the Barrett joint, he certainly thought, as a metal-to-metal joint, it presented a great element of security—especially when so much depended, as it did to-day, upon the fitters, who could not be watched all through a job. In the case of a compressor being fixed on a low-pressure supply, would not the author consider it advisable to bye-pass the compressor, so that it could be attended to at any time when necessary? In giving estimates and specifications for lighting, Mr. Hodgkin said it was necessary to be extremely careful in all statements concerning candle power. This was one of the best points brought out in the paper, and was one that could not be emphasized too much.

Mr. W. Gibbs (Birmingham) remarked that, though the author had covered a great deal of ground in his paper, there was still another big use for high-pressure gas—for distribution to outlying districts. No doubt it was going to be one of the saviours of the gas undertakings in large towns; for the simple reason that outlying districts had a habit of developing beyond the expectation of anyone, and so big problems had to be suddenly faced. A manufacturer at his office or works in town was accustomed to a good light with high or low pressure; whereas at his home he might have a variable pressure, and the same burners would not give good results. For boosting-up purposes, high-pressure distribution was going to be of great help to them. A dissatisfied consumer at home was going to be a dissatisfied consumer at his works. As to jointing material, Birmingham was working with tremendously high pressures—higher, he supposed, than any other town—and he found the men were fully realizing the responsibilities of these high pressures. It was not always a question of material. He came across fittings and taps—more especially cast taps—that could be tested to 15 lbs. or 16 lbs., and would remain sound for perhaps a week or a fortnight, and then if the installation was visited again at the end of this period, they might be leaking. In connection with all cast fittings, great care should be taken. Makers were realizing this; but it should be specified in contracts that such fittings should be subjected to a very stringent test.

Mr. W. H. Johns (Saltley) seconded the vote of thanks, which was carried by acclamation.

Mr. Hodgkin, replying to the discussion, referred first to the question of bending 10-inch and 8-inch steel tube, and said he had found that with a hydraulic jack this could be done without any trouble. Passing to other points, he thought the majority of service and main layers appreciated the fact that a main must be carefully wrapped. He believed, to a certain extent, if they coated the inside of tubes, this acted, particularly with some makes of gas, as a non-conductor of heat. It was said that they never had any naphthalene collect with high-pressure gas; but, as a matter of fact, though it surprised him, he knew that naphthalene had collected in high-pressure tubing. If the inside of a tube was coated, in addition to preserving it from corrosion, they had a non-conductor of heat, which meant that the pipes were kept on the inside at a fairly even temperature, and there was no deposition of naphthalene in any quantity. Possibly the nipples and ferrules of the Barrett joint did retard the flow of gas to a certain extent; but the amount of the retardation was very small, hardly enough to be taken into serious consideration. In fact, he did not think it was more than would be caused by the rough edge of a pipe. Mr. Smith had made some very interesting remarks; and, of course, he was not going to attempt to answer all he had said, because he considered—as he believed the majority of people did—that Mr. Smith had not at the present time an equal where high-pressure gas was concerned. The pressure he spoke of in the paper should not be taken as the absolute pressure in every case, but merely as a general pressure used in many instances. As to what he had said about creosote, this should be taken more as a suggestion. It was one of the things with which they ought to experiment. He considered that at the present time there was not half enough experimenting carried out in the industry; and all points connected with high-pressure gas should be investigated. There were no end of men who, if they received encouragement

to experiment, would do so, and there would be some very good results. The creosote was a special preparation, and almost a secret one. He himself did not know the chemical composition of it, and could not find out. The figures in connection with metal melting were not given as definite figures, but merely as approximate ones, to furnish a manufacturer or an outside man with a general idea as to the cost of melting. Of course, the cost of gas varied in different towns.

Mr. SMITH: You quote figures for cost per cwt.

Mr. HODGKIN remarked that he had omitted this. The cost of the gas should be 1s. 4d. per 1000 cubic feet, less 5 per cent. One great point Mr. Smith had touched upon was the loss of metal by oxidation. In many cases, he believed, this was the deciding factor. Very often the loss ran up to (say) 5 per cent. with coke or oil; whereas with gas it might be not more than 1 per cent. This meant in 100 lbs. of metal a net gain of 4 lbs. in the metal cast, not castings, which must be set against the general cost. It was sometimes a difficult point to get a manufacturer to see. The burner spoken of was one of Brayshaw's, in connection with air-blast furnaces. Mr. Marsh had put a question about governors. There might be a dozen or more makes. He simply took the leather diaphragm and mercury ones as illustrations. With regard to the point about reduction of pressure, he was not quite clear as to what Mr. Marsh meant; but the idea was to reduce the pressure as much as possible, and not affect the volume of gas that was flowing through. Mr. Marsh asked what had become of the thirty-first lamp. Well, he was afraid this had been lost; but there were two lanterns on one standard, each of 4000-candle power. He knew that makers went to some considerable trouble in regard to the calibration of springs, to try and get them exactly right for the particular weight that they had to carry. With reference to Mr. Pratt's remarks, he was aware that in the South of England it was not always the custom to cover the pipes. Expense was, of course, a great consideration. He took it for granted that every compressor was bye-passed. This should be done, no matter what compressor it was. Then Mr. Gibbs had alluded to high pressure for outside districts. This matter had been dealt with recently in great detail, and therefore he did not go into it. It was an undoubted fact that outside districts were in the majority of cases neglected. It was often found that in the centre of a town there was any amount of gas, but that when they reached the outlying districts (which sprang up and developed very rapidly), the supply was short. This meant an advantage to the electric people, when they got their cables there. Something had been said about leaky high-pressure fittings. He himself had found that fittings would stand for a month perhaps, and then they might begin to leak very badly. This was another thing that emphasized the remark made at the commencement of the paper. If they had a British gas engineers' research laboratory, these fittings would be thoroughly tested, and the makers who did not keep up to a certain standard would then have their fittings scrapped. He thanked them for the way in which they had received his paper.

THE INTERNATIONAL GAS EXHIBITION AT ANTWERP.

Awards to Exhibitors.

A description of the Antwerp Gas Exhibition and some of the exhibits was given in the number of the "JOURNAL" for Feb. 25 [pp. 518-19]. We have now received the list of awards made by the judges, Messrs. Brender à Brandis, Degand, Maris, Portielje, Salomons, Terwagne, and Trifet. Among them are the following:

Grand Prix.

Nestor Martin; George Wilson; Société Anonyme "Bec Auer"; Compagnie Belge pour la Fabrication des Compteurs.

Gold Medals.

William Sugg and Co., Limited; Charles Rey and Co.; Union Gazière; Usines Pintsch; Friedrich Lux; F. Richard and Co.; Bernard Young; J. Schoeters and Co.; Fletcher, Russell, and Co.; Ehrich and Graetz; Richmond Gas Stove and Meter Company; Carron Company; John Wright and Co.; Parkinson Stove Company, Limited; Davis Gas-Stove Company, Limited; Compagnie Continentale pour la Fabrication des Compteurs; Hollandsche Residugas Maatschappy; Burt, Boulton, and Haywood; Standard Hardware; Société Anonyme des Moteurs Otto Deutz; Société Chaleur et Lumière; Berlin-Anhaltische Maschinenbau A.G.; Schulze (of Ghent).

Silver Medals.

Cannon Iron Foundries, Limited; G. Kromschroeder; Stuart Turner, Limited; J. Morisons.

We learn from Mr. A. F. P. Hayman that the exhibition (which closed last night) continued its successful career, in the matter of attendances of the public, to the very end. Among other distinguished visitors, Mr. Hayman recently received M. Hubert, the Belgian Ministre de l'Industrie et du Travail, who thoroughly inspected all the stands, and, on leaving the building, expressed his great satisfaction with all he had seen.

THE VAPOUR PRESSURE OF NAPHTHALENE.

A communication addressed by Herr E. Schlumberger to the "Journal für Gasbeleuchtung" for Dec. 21, 1912, gives an account of researches made by him at the Chemical-Technical Institute of the Technical College at Carlsruhe, on the "Vapour Pressure of Naphthalene, and the Determination of Naphthalene in Purified Gas." Though the vapour pressure of naphthalene at different temperatures has been determined by earlier investigators, yet, owing to the fact that the extent to which deposition of naphthalene from coal gas will occur with a given fall of temperature depends primarily on the difference between its vapour pressures at the initial and final temperatures, the values are of so much importance to gas engineers that the revised figures given by Herr Schlumberger will be welcome.

Herr Schlumberger first refers to the researches of Mr. R. W. Allen in 1900 [see "JOURNAL," Vol. LXXV., pp. 673, 1003], which gave the vapour pressure of naphthalene for the range of temperature 32° to 266° Fahr. He states that the figures given by Allen for the lower temperatures were obtained by extrapolation from those found experimentally for the higher temperatures. [But this is scarcely correct, as reference to Mr. Allen's papers, *loc. cit.*, will show.] He set out to determine experimentally the vapour pressure values for the lower temperatures.

The method adopted in the investigation was the flow method, the principle of which is that the quantity is measured of the substance which volatilizes into a known volume of gas, in order to saturate it at a known temperature. Thus a certain quantity of some gas—air is the simplest—is passed at a constant temperature over naphthalene so slowly that saturation takes place during the time of contact. The amount of naphthalene in the gas is then determined. The total volume of air and naphthalene vapour is kept at a particular pressure, which may be about the atmospheric pressure. Then if

p = the vapour pressure, in millimetres of mercury, of the naphthalene
v = litres of air and naphthalene vapour (the volume of the latter is so small compared with that of the air that it may be neglected)
G = grammes of the naphthalene vapour
M = 128 (the molecular weight of naphthalene)
$\frac{G}{M} = n$ = the number of molecules of naphthalene evaporated
T = the temperature on the absolute scale of the gas space saturated with naphthalene

It follows from the fundamental law of gases that

$$p\,v = n\,R\,T,$$

in which R (for the units used) has the value 0·082 litre-atmosphere. Therefore, if the values of p, v, T, and R are known or found, the value of n (and consequently of G) may be calculated.

The apparatus used was as follows: A water-injector forced the air into a 40-litre flask, from which a sufficiently constant current of air could be drawn through a constriction. This current of air was dried with calcium chloride, phosphorus pentoxide, and finally by cooling with solid carbonic acid. It was then warmed by passage through a copper cylinder filled with copper turnings kept at the same temperature as the naphthalene saturating tube, into which it then passed. The tube was kept at the required constant temperature in the usual manner, by means of a thermo-regulator and stirrer. The temperature was read on a standardized thermometer divided into tenths of a degree. After it had passed through the saturating tube, the air entered condensing apparatus in which the naphthalene was extracted by condensation in stages. This apparatus consisted of two U-tubes, of which the first was cooled by ice and the second by solid carbonic acid. The air then passed through drying tubes containing phosphorus pentoxide and calcium chloride, and finally through a meter. A mercury pressure-gauge was attached between the last drying tube and the meter. A thermometer was inserted in the meter, which was proved from time to time. The connections between the naphthalene saturating tube and the condensing vessels were of glass. Both the decrease of weight of the saturating tube and the increase of weight of the condensing tubes were ascertained and agreed within the limits of experimental error. The naphthalene used was purified by repeated washing, re-crystallization and distillation.

A temperature of 32° Fahr. was maintained in the first condensing tube by dipping the U-tube into a metal box insulated on the outside by air and wadding. The box was filled with finely-crushed ice. The water resulting from the melting of the ice ran away at the bottom. The charge of ice lasted eight to ten hours, and the temperature was checked by means of a thermometer. The second condensing U-tube dipped into a Dewar flask charged with carbonic acid powder. The charge had to be renewed after about three hours. If the air was not completely dry when it entered the saturating tube, a fine precipitation of water occurred locally in the second condensing tube. This precipitate could be removed at the end of the experiment by passing air saturated with naphthalene through the vessel. Only the water was thus volatilized. Obviously, the air must have been

saturated with naphthalene at the same temperature as that of the U-tube. The author has preferred to work by drying the air completely before it entered the saturating tube, in order to avoid any deposition of water in the second condensing tube.

The first experiments were made at 32° Fahr. In this case, it was not necessary to use condensation with carbonic acid. The drying of the air with carbonic acid also was dispensed with, because air dried with phosphorus pentoxide does not deposit any trace of moisture at 32° Fahr. The experiments were thus simplified. Naphthalene remaining in the air escaping from the ice condensing tube could readily be calculated from its known vapour pressure at 32° Fahr. and the volume of air, and added to the weight of naphthalene found in the ice condensing tube.

An example will make the method of calculation clear:

Temperature of thermostat = 50° C. + 273° = 323° absolute.
Volume of air measured = 24 litres.
Corrected volume of air $v = 24{\cdot}5$ litres.
Temperature of meter $t = 19°$ C.
Mean barometer reading $b = 752$ mm.
Tension of aqueous vapour at 19° C. $a = 16{\cdot}4$ mm.
Volume of air corrected to 0° C. and 760 mm. is:

$$v_0 = \frac{v \times (b - a)}{760 \times \left(1 + \frac{t}{273}\right)}$$

Volume of air at 50° C. and 752 mm. + excess pressure in the apparatus—viz., 11·8 mm. and dry is:

$$v_{50} = \frac{v_0 \times 760 \times \left(1 + \frac{50}{273}\right)}{(752 + 11{\cdot}8)} = 26{\cdot}1 \text{ litres.}$$

These 26·1 litres of air had carried forward 0·1351 gramme of naphthalene, according to the weighings of both the saturating and the condensation tubes. Consequently, 1 cubic metre carried 5·1764 grammes, and the vapour pressure $p = 0{\cdot}815$ mm. of mercury.

An experiment about 13° C. was carried out by supplying the thermostat with running well water, the temperature of which fell gradually during a day from 12·8° C. at 8 o'clock in the morning to 12·5° C. at 8 o'clock in the evening. The rate of flow of the air was varied in all the experiments to such an extent that further reduction of the flow caused no change in the saturation values. The rate of flow in all the experiments varied between 1 and 3 litres per hour, and consequently a single experiment lasted ten to fifteen hours. The figures obtained by the author are given in the following table.

Temperature.		Vapour Pressure.	Naphthalene Vapour.	
Degrees Centigrade.	Degrees Fahrenheit.	Millimetres of Mercury.	Grammes per 100 Cubic Metres.	Grains per 100 Cubic Feet.
0	32	0·006	4·51	1·97
5	41	0·010	7·38	3·23
10	50	0·021	15·23	6·66
15	59	0·035	24·95	10·90
20	68	0·054	37·83	16·53
25	77	0·082	56·48	24·68
30	86	0·133	90·10	39·37
35	95	0·210	139·96	61·16
40	104	0·320	209·88	91·72
45	113	0·518	334·39	146·13
50	122	0 815	517·94	226·34

As from the 1st prox., several changes will be made in the salaries of officials in the Gas Department of the Southport Corporation. Among them is an increase of £25 per annum in the case of Mr. J. E. Blundell, the Outdoor Superintendent; and the maximum salary of Mr. R. Walmsley, the Assistant Gas Engineer, is fixed at £275 per annum.

A report [Technical Paper No. 26], dealing with the determination of the sulphur content of fuels, was recently issued by Messrs. J. C. Allen and J. W. Robertson for the Bureau of Mines, Washington. The inquiry was undertaken as a result of numerous observations of corrosions in furnaces and the cylinders of explosion motors, which were traced to the sulphur content of the fuel used. The paper contains a comprehensive comparison of known existing methods, pointing out the advantages and disadvantages of each. All kinds of fuel are dealt with; but most attention is paid to petroleum.

The Manchester City Council, at a meeting last Wednesday, had submitted to them a recommendation of the Gas Committee that the salary of the Chief Engineer, Mr. J. G. Newbigging, be increased from £1200 to £1300 per annum, as from Jan. 1, 1913, from £1300 to £1400 per annum as from Jan. 1, 1914, and from £1400 to £1500 a year as from Jan. 1, 1915; and, in addition to his present duties as Engineer in connection with the manufacture of gas, he be also given control of, and held responsible for, the public lighting of the streets so far as gas is concerned within the city, and for the distribution of the gas up to the consumer's meter. Mr. William Kay (the Chairman of the Committee) was about to speak in support of the recommendation, when there were loud cries of "Agreed," and Alderman M'Cabe suggested that the Chairman should reserve his remarks. The recommendation was then approved.

ERECTING AND OPERATING GAS CALORIMETERS.

In response to a demand by members of the American Gas Institute for directions for erecting and operating gas calorimeters, the Committee on Calorimetry," whose report has just been summarized in the "JOURNAL" [see *ante*, pp. 399, 459, 548], have issued a set of instructions and rules as a supplement to the report; and a copy has been forwarded to us by the Chairman, Mr. J. B. Klumpp. They relate generally to calorimeters of the continuous-flow water-heater type; but the Committee have also included some remarks on other calorimeters which are on the water-heating principle, but differ in design and in the application of the principle. The heating value of a gas, as indicated by the calorimeter, when operated according to the instructions, is that defined and adopted by the American Gas Institute. The unit of volume is the cubic foot; and the Committee recommend that the heating value should be stated in terms of British thermal units per cubic foot.

After a few introductory remarks, the Committee indicate the precautions to be taken in selecting and operating calorimeters of the Junkers type; but where the instructions differ for other types (such as the Doherty, the Parr, &c.), additional notes are given. To facilitate the operation of calorimeters at the various gas-works, the Committee say the instruments should preferably be installed in a cabinet made as dust-tight as practicable. It should provide for an overhead water-tank, and may be conveniently located adjacent to a sink and water supply. It should not be near any gas-flame, heating register, or other radiator. Direct sunlight should not be allowed to strike upon it; but the thermometers and meter should receive sufficient reflected artificial light to enable them to be easily read. Since draughts must be rigorously excluded, it is better, wherever possible, to set aside a room solely for the use of the calorimetric outfit.

The Committee next give the following

DIRECTIONS FOR ERECTING AND OPERATING A CALORIMETER.

On unpacking the calorimeter, see that it is cleaned inside and out, and free of packing material. Study carefully the maker's erecting directions and illustrations, and see that all parts are included. Handle the thermometers with the greatest care. The calorimeter should be set up in a quiet, light, and well-ventilated room or cabinet, which is free from draughts, and in which the temperature can be maintained constant at not less than 60° Fahr. The room should be provided with a sink and with a good supply of running water. It is advisable to have a large shallow overhead covered tank, from which the water supply can be taken. Should the tank capacity be small, and not hold enough water for a prolonged series of readings, a small gas water-heater may be employed to bring the water to approximately the room temperature. It is desirable to use water in the calorimeter that is clear and free from suspended matter; therefore a filter should be installed in the water-supply line before it enters the overhead tank.

If only a single test is wanted, gas may be taken from the house piping; but if an average value is required, a small gasholder, or averaging tank, should be used, and the gas flowing into the holder adjusted to a rate of flow to just fill it in the time during which the sample is being drawn. Care should be taken to have a short service to this holder, in order that an average sample of gas may be obtained; and if the sample be taken from a line on which there is no considerable consumption, the operator should see that the line is thoroughly purged before sampling. It is recommended that the gas should be metered at a pressure not to exceed 2 inches of water. If this is not obtainable, it is advisable to insert a holder or diaphragm governor in the supply line to reduce the pressure to within this limit.

Set up the calorimeter so that the overflow and outlet water can be easily led to the sink. Make water connections with rubber tubing, being careful not to cramp the tubing. To avoid air currents caused by the movement of the observer's body, set up the calorimeter so that the water supply and waste may be easily adjusted, and that all temperatures may be readily observed. Lead the outlet water to a waste funnel supported a little above the top of the copper or glass container used to collect the water, so that the water can be shifted from the funnel to the container and back without spilling.

Set up the gas-meter facing the observer, and level it carefully. Then adjust the water-level of the meter—both inlet and outlet being open to the air. To do this, remove the plug from the dry well, open the funnel cock, and disconnect the tubing on the outlet of the meter. Add or remove water (through the funnel or by the cock under the gauge glass) until the lowest edge of the meniscus just touches the scratch on the gauge glass, or is even with the fixed pointer. If the meter has been filled with fresh water, the gas must be allowed to burn at least two hours before making a test. When the water in the meter is saturated with gas, 20 minutes should be sufficient. Fill the pressure regulator with water, then connect it to the calorimeter burner. Metallic tubing is preferable; but when rubber tubing is used to connect the meter, pressure regulator, and burner, the connections should be as short as possible, and should be saturated with the gas.

Turn on the gas, and allow it to burn for five to ten minutes with the burner on the table. Shut off the gas at the burner and watch the hand on the meter for leakage. Be sure that all leaks are stopped before attempting to make a test. Start the water

running through the calorimeter at a rate of about 3 lbs. per minute. Then regulate the gas to flow at the rate of 4 to 7 feet an hour, as may be found by experiment to give the highest result with the gas to be tested, admitting enough air through the burner for the flame to show a faint luminous tip. Insert the burner as far up into the combustion chamber as the bracket permits, and observe again the condition of the flame to see that it is all right, using a mirror.

The excess of air passing through the calorimeter is controlled somewhat by the position of the damper in the exhaust port; and the best results are obtained by having the excess air as low as possible and still maintaining complete combustion of the gas. To determine this position of the damper, some experimentation may be necessary. Operate the calorimeter until a thermal balance is established on the inlet and outlet water thermometers. Start with the damper closed, then open slightly, observing carefully the outlet thermometer. When this thermometer reads at a maximum—or, in other words, when the greatest rise in temperature is given to the water, which is presumably passing through the calorimeter uniformly—the damper is in approximately the correct position for the amount of gas being burned, and the excess air necessary for perfect combustion is at a minimum. Water should be regulated so that there is a difference between the inlet and outlet temperatures of about 15° Fahr. The temperature of the inlet water should vary but little when an overhead tank is used and the water maintained at room temperature. Be sure that both overflows are running.

Before making the test, the barometer, temperature of the gas at the meter, temperature of the room, and temperature of the exhaust products should be recorded. It is desirable to have the temperature of the inlet water and the temperature of the exhaust products as nearly as possible at the room temperature, in order to establish more nearly a thermal balance. The difference in these temperatures should never exceed 5°. Next allow the gas to burn in the calorimeter until a thermal balance is established, or until there is the least change in the inlet and outlet waters.

The test may now be started by shifting the outlet water from the funnel to the container just as the large hand on the meter passes the zero point. Readings are then made of inlet and outlet thermometers, making the readings as rapidly as the observer is able to record them during the consumption preferably of 0·2 cubic foot of gas. At least ten readings should be made of both inlet and outlet water temperatures. Water is again shifted from the container to the waste funnel as the hand passes the zero point the second time. Water is then weighed or measured. The uncorrected heating value per cubic foot is obtained by multiplying the difference of the averages of the inlet and outlet temperatures by the number of pounds of water, and dividing by 0·2. This quantity is divided by the correction factor for the barometer and temperature, obtainable from tables, to give the heating value at 30 inches pressure and 60° Fahr. The weight or contents of the container should be obtained while the inside is wet. This may be done by filling it with water, emptying, and shaking for about five seconds in an inverted position. This will do away with any correction where several consecutive tests are required with the same container.

A second, and perhaps a third, test is advisable, and should be made without disturbing the existing conditions, provided all readings are within the limits prescribed. In practice, the operator should get consecutive results on the same holder of gas within 10 B.Th.U. Under such conditions, an average of the results may safely be taken.

The method of calculating the calorific value of the gas from the observations indicated is very simple when all readings are made in English units, as recommended, and entered in some form conveniently arranged. The averages of the inlet and outlet water temperatures are determined and necessary corrections for thermometer errors are made. The difference in these averages should give the rise in temperature of the water. This rise in temperature of the water is then multiplied by the number of pounds of water passed through the calorimeter during the test. The product of these two is then divided by the quantity of gas burned—0·2 cubic foot. This quotient will give the heating value of one cubic foot of gas in B.Th.U. at the indicated temperature and barometric pressure. To correct this to 60° Fahr. and 30 inches pressure, divide by the "correction factor" for the indicated temperature and pressure as obtained from some standard table. The final result will be the corrected heating value of the gas tested in British thermal units.

Some Precautions.

The Committee give the following precautions:

Don't place the lighted burner in the calorimeter when the water is not running through.

Don't shut off the water while the gas is burning; but if the water is accidentally shut off, then shut off the gas quickly to avoid breaking the thermometers.

Don't move suddenly near the instrument during a test. Slight draughts thus caused will vary the outlet readings and vitiate the test.

Don't fail to check daily the water-level in the gas-meter.

Don't forget to test the meter and all connections daily for leakages.

Don't erect the calorimeter too close to any heating or lighting appliances, where radiant heat might affect the readings.

Don't make the test with the inlet water temperature more than 5° above or below the temperature of the room.

Don't fail to fill the overhead tank with water when through with the testing, so that it will be ready for the next test.

The Committee point out that an error of 0·1° Fahr. in the temperature of the water means an error of about 4 B.Th.U. in the gas; that an error of 0·01 lb. of water when burning 0·2 cubic foot of gas in the test means an error of about 0·9 B.Th.U. in the gas; that an error of 1° in the temperature of the gas means an error of about 1·8 B.Th.U.; that an error of 0·1 inch in the barometer reading means an error of about 2 B.Th.U.; and that, when metering the gas, each additional inch of water pressure to which the gas is subjected means an error of about 1·5 B.Th.U.

Corrections for Atmospheric Humidity.

The Committee close their instructions with some remarks on operating the Doherty and Parr calorimeters and on making corrections for atmospheric humidity. They remark that this correction is found to be the greatest when the percentage of humidity of the atmosphere is the lowest; the reason being that the relatively dry air entering the calorimeter causes to be carried out in the exhaust products a larger amount of the water in the form of a gas or vapour, which is formed by the combustion of the gas, and which does not condense, and therefore does not give up its latent heat to the calorimeter. The humidity correction should correct for any discrepancy in water vapour carried in by the air and gas, compared with that carried out by the products of combustion. Owing to the contraction in volume during the combustion of ordinary illuminating gas and air, this discrepancy is practically nothing when the percentage of atmospheric humidity is about 80 per cent. at normal temperatures, and the excess of air introduced for combustion is about 30 per cent. In correcting for atmospheric humidity, it is assumed that the gas is saturated with water vapour, having passed through a wet meter. This assumption may not be absolutely true, but the percentage of saturation has been found always to be high; and as the volume of gas is only about one-eighth of the mixture, the error involved may be neglected.

The Committee give the following table of corrections (expressed in B.Th.U.) of the observed heat to get the total heat value, if seven volumes of air per volume of gas are used. The temperatures are those of the room.

Humidity Per Cent.	65° F.	70° F.	75° F.	80° F.	85° F.	90° F.
10	+4·8	+5·7	+6·7	+7 9	+9·2	+10·5
20	+4·1	+4·9	+5·7	+6·8	+7·8	+ 9·0
30	+3·4	+4·1	+4·7	+5·6	+6·5	+ 7·4
40	+2·7	+3·2	+3·7	+4·5	+5·2	+ 5·9
50	+2·0	+2·4	+2·8	+3·4	+3·8	+ 4·3
60	+1·3	+1·6	+1·8	+2·2	+2·5	+ 2·8
70	+0·6	+0·8	+0·8	+1·0	+1·2	+ 1·2
80	−0·1	±0·0	−0 1	−0·1	−0·1	− 0·3
90	−0·8	−0·9	−1·1	−1·3	−1·5	− 1·9
100	−1·6	−1·8	−2·0	−2·4	−2·8	− 3·4

ANALYZING SULPHATE OF AMMONIA.

The number of the "Journal des Usines à Gaz" for the 5th inst. describes a simple method of analyzing sulphate of ammonia which can be carried out in less time than is usually required, and without the use of a distilling apparatus. The method has been devised by M. Ch. Ab-der-Halden, the Engineer-Chemist of the Continental Union Gas Company. It is based upon the following reaction: If into a solution of sulphate of ammonia there is poured a solution of caustic baryta, all the sulphuric acid contained in the sulphate passes into sulphate of barium, and the ammonia is liberated, according to the following equation—

$$(NH_4)_2\,SO_4 + Ba\,O = Ba\,SO_4 + 2\,NH_3 + H_2O.$$

If the strength of the baryta water before and after its admixture with the sulphate is known, the loss of strength corresponds with the sulphuric acid; and the content of ammonia, and afterwards of pure sulphate, can be easily deduced.

In operation, a solution of commercial sulphate, containing exactly 20 grammes of salt per litre, is taken, and 50 c.c. (1 gramme of sulphate) are placed in a 250 c.c. flask. To this are added 100 c.c. of baryta water, and the mixture is brought to boiling-point, and continued till the escaping vapour no longer gives a blue colour to litmus paper (10 to 15 minutes). The mixture is then cooled quickly, and the excess of baryta ascertained by means of normal sulphuric acid in the presence of helianthine as an indicator. The difference corresponds to the quantity of sulphuric acid required to saturate the ammonia in the sulphate. If, as frequently happens, the latter contains a small quantity of free sulphuric acid, it is necessary, before adding the baryta water, to neutralize this acidity by the requisite quantity of baryta. The total duration of the operation is 20 minutes; whereas the ordinary distillation method occupies 45 minutes to an hour.

The following is an example of an analysis of grey sulphate: Strength of 100 c.c. of baryta water before the test, 19·6 c.c.; strength after the test, 5·2 c.c.; sulphuric acid corresponding to ammonia, 14·4 c.c. Nitrogen, 20·16 per cent.; ammonia, 24·48 per cent.; pure sulphate, 94·98 per cent. An analysis of the same sulphate by the ordinary method gave the following percentage results: Nitrogen, 20·02; ammonia, 24·31; pure sulphate, 94·32.

LEGAL SPECIFICATIONS FOR ILLUMINATING GAS IN AMERICA.

From time to time the "Journal of the Franklin Institute" publishes "Notes from the U.S. Bureau of Standards;" and the number for February [Vol. CLXXV., p. 163] had one on "The Legal Specifications for Illuminating Gas," prepared by Dr. E. B. Rosa, the Chief Physicist, and Mr. R. S. M'Bride, the Assistant-Chemist at the Bureau. It is pointed out that the revision of the Bureau of Standards Circular No. 32, on "State and Municipal Regulations for the Quality, Distribution, and Testing of Illuminating Gas," was discussed at the last meeting of the American Gas Institute, in connection with the presentation of a report by the Committee on the "Thermal Value and Candle Power of Gas" [see "JOURNAL" for Dec. 24, p. 968]. Messrs. Rosa and M'Bride say that a consideration of relative merits of candle-power and heating value regulations as the basis of the legal specifications for gas quality indicates the greater advantage of the heating value standard as the principal basis for the regulations. However, they maintain that it will, in general, be best to retain a candle-power limit in municipal ordinances for the protection of open-flame burner users. The candle-power limit should be so low as to be less than the value which will ordinarily be met by present-day methods, in order that no undue expense of manufacture will result from its presence in the law. In effect, it will serve only to hold gas manufacture along present methods until it is shown that other methods operate to the advantage of the gas user; and it thus prevents changes in manufacture profitable to the company without a new basis of specification which will ensure that the customer is given some sort of advantage in the change.

A full discussion of the "net" and "total" heating values, they continue, indicates the significance of each, and either may be used with perfect fairness and without any uncertainty. A new method of computing the total heating value by correction for the latent heat of the water vapour carried out of the calorimeter is indicated; and this method is recommended for general adoption in official testing where an accuracy greater than 2 per cent. is needed.

Some errors in the current method of calculation of candle-power of gas are indicated. These are very large in cities of high altitude. No entirely satisfactory means of eliminating the irregularity is at present available; but further work on the subject is promised by the Bureau, with the idea of gathering such data as will permit a fairer and more satisfactory system of gas candle-power rating.

The use of an open-flame test-burner for gas candle-power measurements is again recommended; and a number of the phases of gas quality regulation are briefly discussed.

Improvements in Water-Gas Plant.

We learn from the Economical Gas Apparatus Construction Company, Limited, of 13, Victoria Street, Westminster, that new interests (including two of the leading water-gas engineers in America) recently acquired control of the Company, with a view to revolutionary improvement of the plant. Radical preliminary changes having, they say, proved that the new plant will give high results for low capital expenditure, Mr. A. G. Glasgow has consented to join the Board, to assist locally in perfecting the apparatus. Messrs. Humphreys and Glasgow, Limited, it is added, have no interest in the Company referred to.

Masonic—Murdoch Lodge.

The installation meeting of this Lodge was held at the Imperial Hotel, Birmingham, last Thursday, when W. Bro. Vincent Hughes, P.M. 2582, was installed W.M. for the ensuing year. The other officers of the lodge invested were:

I.P.M., W.Bro. Charles Dakin, P.M. 573, P.P.G.D. (Worcester).
Senior Warden, W.Bro. Alfred Thos. Harris, P.M. 1330, Prov. G.P. (Leicester).
Junior Warden, Bro. Sidney O. Stephenson, S.W. 2385.
Chaplain, W.Bro. Luke B. Taylor, P.M. 347.
Treasurer, W.Bro. Thos. Berridge, P.M. 1085, P.P.G.D. (Derbyshire).
Secretary, W.Bro. Adam Cooke, P.M. 2385, P.P.G.D.C. (Worcester).
Senior Deacon, W.Bro. Sidney P. Thornton.
Junior Deacon, Bro. Harold G. Eveson.
Director of Ceremonies, W.Bro. Fred Vale, P.M. 560, P.P.G.A. Sec. (Worcester).
Assistant D.C., Bro. Alfred Bird.
Charity Steward, W.Bro. Charles Meiklejohn, P.M. 502, 3480, P.P.A.D.C., P.P.G.W.
Organist, Bro. A. C. Scrivener.
Assistant Secretary, Bro. W. J. R. Baker.
Inner Guard, Bro. Robert Scott.
Stewards, Bros. H. J. Woodfine, F. Jervis, A. Withers, and H. Parker.

At the first meeting of the Belfast City and District Water Commissioners after the triennial elections, it was decided to increase the salary of Mr. J. S. Dalzell, of the Engineer's Department, by £25 per annum as from the 1st inst.; a further advance of £25 to take effect on the 1st of March next year.

CORRESPONDENCE.

[We are not responsible for opinions expressed by Correspondents.]

The Abandoned Coal Export Tax.

SIR,—In my last letter, I demonstrated that colliery owners did not possess anything in the nature of a monopoly in coal, and that coal prices were all subject to the laws of supply and demand. In reply, Mr. Carpenter suggests that, if not a monopoly, a combination exists "among colliery owners to determine prices." While I agree with him when he says that it was not "by a series of accidental circumstances that for a million odd tons of coal from half-a-dozen different gentlemen" he had to pay the same increase of price to each, yet I cannot consider that this in itself forms any evidence of the existence of a "combination to determine prices." Is it not rather an exemplification of the power of one of the largest consumers of British coal to dictate prices to the colliery owners? If the prices and the relative increases were fixed by Mr. Carpenter's Company, as I understand they were, then this would go far to demonstrate the great power possessed by a large buyer over against an unorganized crowd of sellers. Unless Mr. Carpenter has some stronger evidence on which to base his contention, I must ask your readers to dismiss from their minds any idea of the existence of a combination among colliery owners.

Mr. Carpenter asks whether I write as a thick-and-thin supporter of the Government, knowing the market only by hearsay. In reply, I beg to state that, far from knowing the coal market only by hearsay, I was selected by the "Royal Commission on Coal Supplies" to give evidence before them on the coal market of Northumberland and Durham; and I did not enter upon this correspondence in your columns with the object of discussing the merits or demerits of the Government, or Italian art treasures, or Bulgarian atrocities, but solely with the desire of showing to your readers how injurious, unfair, and unjust the now happily abandoned coal export duty was to the coal trade and to all the multifarious industries allied to coal mining.

It is no answer to me to state that the coal exports were maintained in quantity in spite of the coal-tax; for the evils of the tax were not alone measured in tonnage, but also in price. I never told Mr. Carpenter that the tax "drove foreign buyers to other markets." What I told him was that "the British collieries had to reduce their prices, in order not to be ousted by German and other foreign competition." And it was this general reduction in prices (in which the London Gas Companies shared) which constituted the hardship to the colliery owner, and, incidentally, during the period of readjustment of prices to costs of marketing the coal, gave the benefit to the home consumer able to take advantage of the situation. The coal export duty did not "restrict our markets," as Mr. Carpenter puts it. What it did do was to restrict our access to foreign markets by adding to our costs an extra shilling per ton on coal sent abroad.

While Mr. Carpenter is not opposed to the export of coal, he would welcome a statesman at the helm who would at the conclusion of the great strike have prohibited the export of coal. Has it ever occurred to him that it would be impossible for merchants to carry on an export business if their contracts with foreigners were not as sacred as those with Englishman are? A statesman at the helm who would use his power to inflict an injury upon one British industry for the benefit of another British industry would not be a patriot, and probably not a statesman.

No doubt all of us who are regular readers of your "JOURNAL" have our interests centred either in the production or the consumption of coal; and while I think it is proper that our individual interests should absorb us, yet as we are all involved in, and dependent upon, the general welfare of our nation, I need make no apology for asking you to append, to this letter, paragraph 121 from the unanimous report of the "Royal Commission on Coal Supplies," issued on the 7th of January, 1905, which was the verdict come to by a group of judicially-minded men with every opportunity of arriving at a dispassionate conclusion.

Newcastle-on-Tyne, March 21, 1913. COAL FITTER.

[ENCLOSURE.]

EXTRACT FROM THE FINAL REPORT OF THE "ROYAL COMMISSION ON COAL SUPPLIES," DATED JAN. 7, 1905.

Effects of Exports of Coal on British Consumers and the Royal Navy.

The witnesses generally were of opinion that the maintenance of a large coal export trade is of supreme importance to the country, and essential to the prosperity of the coal-producing districts. It is said that the larger output rendered possible by the export trade enables the collieries to be worked regularly and to the fullest capacity, and that, the general and fixed charges being spread over a larger tonnage, the average cost of working, and consequently the selling price to the British consumer, can be kept lower than would be the case if the collieries were worked for home consumption only. It was pointed out by some of the witnesses that coal is so essential an element of outward cargoes, that any diminution of our coal export must cause a rise in the import freights on goods, &c. The evidence shows that a large quantity of the coal exported to foreign countries is destined for the use of British ships coaling abroad.

Curious Water Arbitration Awards.—In the matter of land and water rights which the Newry No. 1 Rural District Council have been authorized to acquire for the purpose of providing a water supply for the town and neighbourhood of Rathfriland, Mr. H. W. Andrews, the Arbitrator, has awarded compensation of 1d. each to the Marquis of Downshire, the Bann Reservoir Company, Misses Lindsay, and Messrs. J. T. & Cornelius M'Loughlin, millowners, and certain trustees and occupiers. The other awards were more substantial; the highest, however, reaching only £50.

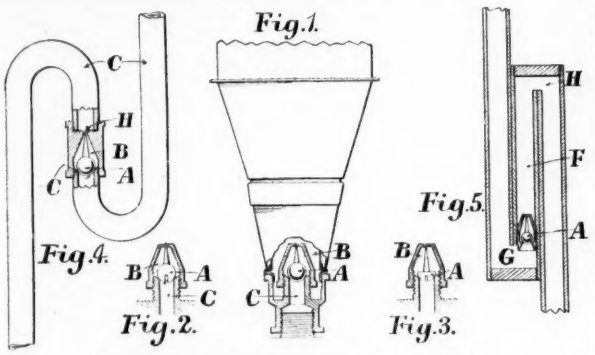
REGISTER OF PATENTS.

Regulating the Supply of Gas to Burners.

PICKARD, WALTER, of Rochdale, and MONKS, H., of Whaley Bridge, near Stockport.

No. 4320; Feb. 21, 1912.

This means for controlling the supply of gas is of the kind wherein a pressure regulator having a floating ball working in a conical chamber is provided with means to prevent the gas being entirely cut off with either abnormally high or low pressure.



Pickard and Monks' Gas-Burner Regulators.

Fig. 1 illustrates the invention applied to an upright burner; and figs. 2 and 3 are modified designs of valves. Figs. 4 and 5 show the invention applied to fittings for inverted lights.

The valve A is arranged in a conical chamber B, and normally rests on a shoulder formed at the base of the cone. An opening at the apex of the cone serves as the outlet for the gas when the valve is unseated. The chamber B is attached by screwing to the pipe C (which preferably forms the valve seating), so as to allow of the cone being adjusted to vary the capacity of the chamber within which the valve works, and also to permit of its regulation according to the average pressure of gas flowing to the burner. While the valve may be of the ball type, it will usually be provided with a pin designed, when the valve is lifted, to enter the opening above the cone, and ensure of a vertical lift to the valve. In this connection the valve may consist of a half sphere with the peg arranged on the flat side, as in fig. 3.

To prevent the valve from cutting off the gas supply under sudden and excessive pressure of gas, small openings are provided which, when the valve is raised sufficiently to close the opening above the cone, allow of just enough gas passing to prevent the light being altogether extinguished. A second cone D (fig. 4) may also be arranged concentric to the cone B, and having an opening corresponding with, and lying directly over, the opening in the cone B.

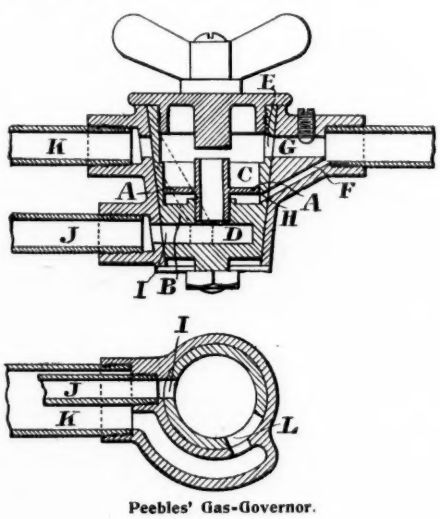
When applied to pendant fittings, the valve A is arranged as shown in fig. 4, or mounted in a special fitting forming a central chamber F with inlet G and outlet H, as fig. 5—the two latter being connected to the gas-pipe C.

Gas-Governors.

PEEBLES, W. C., of Edinburgh.

No. 10,289; May 1, 1912.

This invention has for its object to provide a governor in the body of the cock controlling the supply, but in which the piston or diaphragm is constantly open to the inlet, and is thus "made effective for all open positions of the cock."



Peebles' Gas-Governor.

The illustration shows a vertical section of a gas-governor arranged to supply two superimposed outlet pipes; and also a horizontal section showing an example where the two outlet pipes are concentric.

For the first, there is arranged within the hollow plug shown a governor consisting of a diaphragm or piston A, on a tubular spindle of the kind described in patent No. 3068 of 1894. The lower end of the spindle slides through a central aperture formed through a partition B dividing the interior of the plug into two compartments C D. In the wall of the plug is a port E controlling a similar port and inlet passage admitting the main supply of gas. A regulating screw projects into this passage for the purpose of adjusting the maximum quantity of gas which is to be allowed to pass through the governor, as described in the 1894 specification. When any less quantity of gas than the maximum is desired, the plug is so turned that the inlet port is more or less closed—thus the control of the capacity of the governor passes from the regulating screw to the inlet port E. There is also in the casing of the plug a bye-pass passage F in constant communication, on the one hand, with the inlet passage G, and, on the other hand, by a port H in the wall of the plug with the under or control side of the governor diaphragm or piston A.

In this example, a single outlet port I, in the part of the wall of the plug which surrounds the lower compartment within the plug, controls two discharge ports in the casing of the plug. One of these discharge ports communicates directly with an outlet pipe J, and the other (in the form of a passage in the casing, and shown by dotted lines) communicates with a second superimposed outlet pipe K. On rotation of the plug, the discharge ports are, of course, covered and uncovered successively. The order in which they close is changed, either by altering the direction of rotation of the plug, or by an alteration of the position of the port leading to the top outlet pipe K.

The outlet pipes may, of course, be carried side by side; the outlet and discharge ports being arranged accordingly. Or, as shown in the second arrangement, the outlet pipes J K may be arranged one within the other, and two outlet ports I L may be formed in the wall of the plug, so that both or only one of the discharge ports may be open at one time. When the inner pipe J is shut off, the inlet port E in the plug reduces the amount of gas flowing to what is necessary for the outer tube K only.

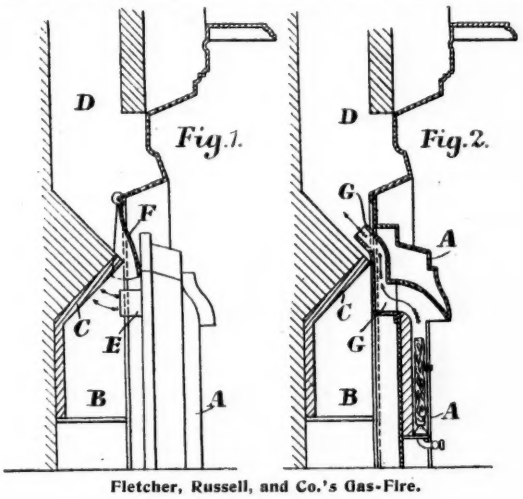
When in use, gas flows through the inlet port E, first to the upper chamber C within the plug cock, and then down through the tubular spindle to the lower compartment D in the plug cock, from which compartment it passes to the outlet pipe or pipes as described; and as the bye-pass passage F in the casing and the port H in the plug ensures that the underside of the diaphragm A is open to the full inlet pressure for all open positions of the cock, "governing in all cases is efficiently performed."

Gas Fires or Stoves.

FLETCHER, RUSSELL, AND CO., LIMITED, and FLETCHER, T. W., of Warrington.

No. 276; Jan. 4, 1913.

The inventors point out that a gas fire or stove is usually provided at the back and towards the top with a horizontal flue for leading off the fumes or products of combustion; and when fitting a gas-fire to a modern coal fire-place having a sloping back, it generally happens that the flue of the gas-fire comes below the sloping back, with the result that the products of combustion are deflected by the back into the room and "cause an obnoxious odour." The object of the present invention is "to provide simple means for overcoming the objections referred to."



Fletcher, Russell, and Co.'s Gas-Fire.

Fig. 1 is a vertical section through a modern coal fire-place fitted with an ordinary gas-fire; fig. 2 is a similar view showing the fire-place fitted with a gas-fire embodying these improvements.

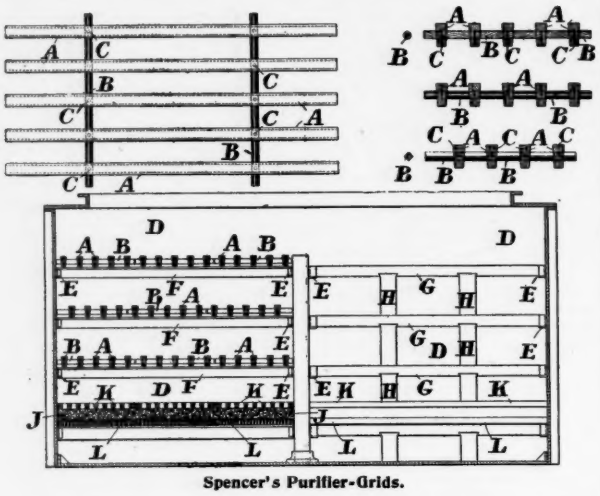
In fig. 1, it will be seen that when an ordinary gas-fire A is fitted to a modern coal fire-place having the grate B provided with a sloping back C, the latter hinders the passage to the chimney D of the products of combustion issuing from the flue E of the gas-fire, and they are to a large extent deflected by the back C into the room. The canopy F might be removed and the front of the fire-place closed in. But in such cases the results are still not satisfactory; and to fit to the flue an elbow extending up into the chimney would necessitate arranging the fire some distance out from the grate. As shown in fig. 2, the gas-fire is provided with a flue G, which leads above the sloping back of the grate and opens into the chimney. By such an arrangement of flue the products of combustion are led direct into the chimney and are not deflected into the room. In order that the flue G shall not necessitate the fire being set out from the grate to any appreciable greater extent than usual, the flue "is preferably of small dimensions from front to back and of considerably larger dimensions from side to side."

Supporting Grids in Gas-Purifiers.

SPENCER, W., of Elland.

No. 5771; March 7, 1912.

The object of this invention is to so arrange and support the grid that in place of the purifying material being filled in in successive layers it may be tipped into the purifier from the top, and, "in falling from tier to tier, is broken up and subsequently built-up from the bottom and supported in a light porous mass, giving far greater efficiency in filtration than the ordinary flat grid."



Spencer's Purifier-Grids.

The grid is made of a number of ordinary shaped taper supporting bars A, retained in position by tie-rods or cross-bars B, which pass through holes, preferably centrally situated in the side of the bars A, and are prevented from shifting their position by pegs or dowel pins C. The ends of the horizontal supporting bars and of the cross-bars project beyond the sides of both in such a manner that, when the purifier is filled with grids, the spaces between the cross-bars B, and between the taper bars A, are approximately the same in each tier.

In order to support the grids within the purifier D, there are fixed to the sides or ends slotted lugs, sockets, or the like E for receiving and supporting the ends of superposed frames or bearers carrying each tier of grids—of T iron as at F, or of wood as at G. Where wood bearers are employed, they are in the form of trestles; the bearers G having legs H on the underside resting upon the bearer of the trestle below.

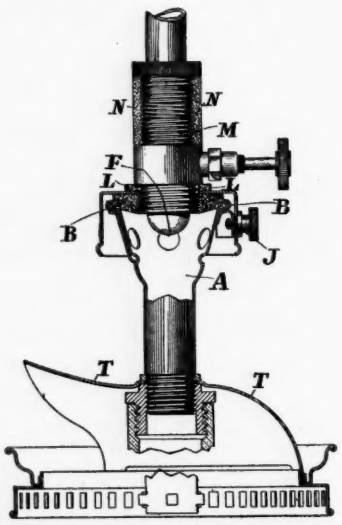
When arranging the grids within the purifier, there is spread over the ordinary bottom grate or grid L, a layer J, of coarse material, upon which is laid an additional series of grids K constructed with the taper bars closer together. The superincumbent weight of the filtering material rests upon the series of grids, and the two with the coarse material are supported by the bottom grate L.

Inverted Incandescent Gas-Burners.

BLAND, C. W., of Little Trinity Lane, E.C.

No. 17,773; July 31, 1912.

This invention relates to insulation devices, whereby efficient protection from heat of the pendant is obtained, so as to prevent it becoming decolorized.



Bland's Insulated Inverted Incandescent Burner.

The top of the mixing-tube A is constructed as a washer or ring B of heat insulating material, secured to the mixing-chamber. The ring has a hole, the wall of which is screw-threaded for receiving a screw-threaded portion of the gas-nipple F, which is provided with the usual needle valve and operating stem. The mixing-chamber (enlarged at its upper end) is provided with air-holes around which is a sleeve also having air-holes to correspond. The sleeve is connected by a screw J, carried in a slot of a canopy encircling the gas-nozzle and resting upon the ring or washer B and serving to protect the air-holes from dust, &c. On the canopy and surrounding the screw-threaded portion of the gas-nozzle is an insulating ring or washer L, to act as an insulator between the canopy and the gas-nipple, and held between a shoulder on the nipple and the canopy. On the upper part of the nipple is a screw-threaded extension M, to which is attached an insulating tube or ferrule N, internally screw-threaded and provided with a tubular socket with an external screw-thread for connection to the insulating ferrule and an internal screw-thread for connection to the gas pendant or bracket pipe. The bottom of the mixing-tube A is provided with a screw-thread, to which can be fixed the usual diverter T, for conveying the products of combustion away from the mixing-tube.

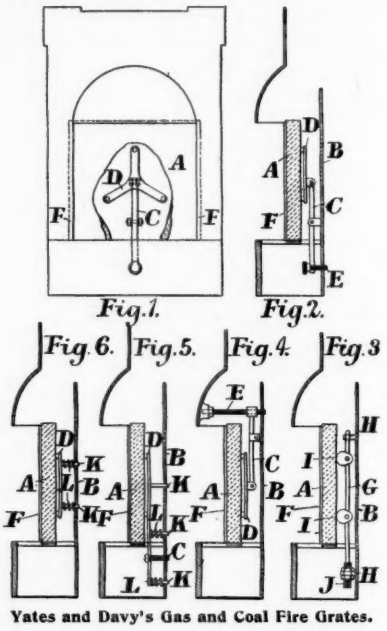
By this invention, the patentee claims that the heat imparted to the mixing-tube A by conduction is first intercepted by the ring B, and any heat imparted to the canopy is intercepted by the washer L, so that the gas-nipple is kept comparatively cool; but should any heat be imparted thereto, it will be further insulated by the tube N, and not be communicated to the gas pendant or bracket pipe.

Gas and Coal Fires.

YATES, H. J., and DAVY, J. F., of Birmingham.

No. 16,788; July 18, 1912. No. 21,810; Sept. 25, 1912.

This combined invention relating to gas and coal fires has for its object to provide improved means for securing a fire-brick back in position, by means of the combination with the grate or frame and brick, of means adapted to exert a clamping pressure on the back of the brick, and to be operated from an accessible position at the front or side of the grate.



Yates and Davy's Gas and Coal Fire Grates.

In carrying the invention into effect for gas-fires as shown in figs. 1 and 2, a fire-brick back A (preferably made in a single piece) is employed, as heretofore; and on the front side of the rear B of the frame or grate which carries it a lever C is mounted, one end of which is arranged to bear upon a point about the centre of the fire-brick back and the other to project sufficiently below the usual burner (not shown) to make it conveniently accessible from the front of the grate. Preferably the upper end of the lever is provided with a pressure or clamping piece D, comprising a combination of three radial arms, by which pressure can be transmitted from the lever to the brick; and the lower end of the lever has inserted through it a screw E which enters a tapped aperture in the back of the grate. By rotating the screw in one direction, the lever is caused to press the brick forward tightly against the inner sides of shoulders F, formed at the front of the grate, and so produce there the required tight joint; while on rotating the screw in the opposite direction, the lever releases the brick, so that it can be readily removed.

The mechanism shown in fig. 3 for securing the brick comprises a vertical rod (between the fire-brick and the back-plate of the frame) supported at its ends in bearings. At convenient positions on the rod, elliptical or other cam pieces are fixed to bear against the back of the brick. When a vertical or rotary movement is imparted to the rod, the cam pieces roll with respect to the brick and impart an outward thrust to the latter against the front shoulders of the frame, or release the brick from the frame, according to the direction of motion.

Fig. 4 shows a modification in which the lever is inverted, and the screw disposed within the canopy or above the fire-brick.

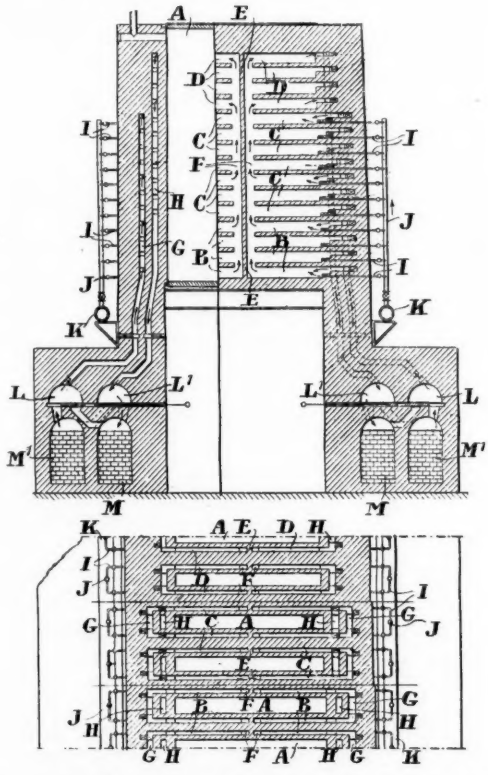
In fig. 6, springs are employed for providing the required security of the fire-brick back; and the clamping piece is here provided with an extension which projects beyond the upper or lower end of the fire-brick, and has inserted through it a screw which enters the back plate of the frame.

Retort Furnaces for Upwardly Tapering Vertical Retorts.

STETTINER CHAMOTTE-FABRIK AKTIEN-GESELLSCHAFT, vormals DIDIER, of Stettin, Germany.

No. 19,097; Aug. 20, 1912. Convention date, April 18, 1912.

This invention relates to retort-furnaces having vertical retorts or chambers tapering upwards, and horizontal heating flues, in which the direction of the heating flames remains constant. In such furnaces, it is well known to connect together each two superimposed heating flues at one end by means of a conduit, while at the other end the lower conduit is connected to a gas and air supply pipe, and the upper conduit to a discharge pipe. Fresh gases therefore flow through the lower heating flue, while the upper heating flue is fed with waste gases from the bottom heating flue. When the furnace is worked with constant direction of the heating flames, this arrangement is disadvantageous, since the coking, more particularly in the bottom portion of the retorts or coking chambers, takes place in an irregular manner, with the result that the furnace works wastefully. The patentees claim that this drawback in furnaces of the above type is obviated by connecting a group of lower heating flues at one end to the gas and air supply pipes, and a group of upper heating flues at one end to the discharge pipes; all the heating flues of the two groups being connected at the other end by a joint conduit, in such a manner that fresh gases can always flow in the same direction through the heating flues of the lower group, and the waste gases escaping from the heating flues of the lower group can pass through the heating flues of the upper group. In this construction, the combustion gases are favourably utilized, and the bottom portion of the retorts or coking chambers can be heated more intensely than the top in accordance with their upwardly decreasing cross section, so as to ensure uniform distillation or coking and economical working of the furnace. To enable exact regulation of the heating to be obtained, there is preferably arranged, between the lower group and the upper group, a central group of heating flues, connected at one end both to gas and air supply pipes and to discharge pipes, and at the other end to the joint passage conduit, so that either fresh gases or waste gases can be passed through the heating flues of the central group.



A German Type of Furnace for Upwardly Tapering Vertical Retorts.

The illustration shows a vertical section and a horizontal cross section of the furnace. The furnace is provided with vertical retorts or coking chambers A, the cross section of which decreases as the retort ascends. B, C, D, show the three groups of horizontal heating flues. The heating flues of the furnace halves are separated from each other by vertical partitions E provided in the centre of the furnace, and those of each half of the furnace are connected together at the inner end by passage conduits F.

In the lateral walls of the furnace are arranged air-distributing conduits G and discharge conduits H, which are regulated by means of slides. The air-distributing conduits G are connected to the heating flues of the lower and the central group at the outer end of these flues, by means of short branch conduits which can be closed by means of slides. The discharge conduits H are similarly connected to the heating flues of the central and of the upper group. The heating flues of the lower group and of the central group are, moreover, connected at the outer end to the gas supply pipes I, controlled by valves, and these pipes I are connected in pairs to a common vertical gas supply pipe J, provided with a stop-cock. The pipes J of each half of the furnace are connected to a main gas supply pipe K.

The air supply and discharge pipes of each half of the furnace are connected to fore chambers L L^1, each of which is connected by two conduits, which can be alternately closed by means of a reversing slide, to the regenerators M M^1 in such a manner that the combustion air is always carried in the same direction through the chambers L and the conduits G, and the waste gases through the conduits H and the chambers L^1.

In these retort-furnaces it is possible to regulate the heating exactly in accordance with the cross sectional area of the upwardly tapering retorts. To ensure uniform coking of the mass of coals contained in the chambers, the supply of heat (in accordance with the upwardly decreasing cross sectional area of this mass) must be made greatest at the level of the lowest heating flues, and smallest at the level of the upper heating flues—being graduated as required between the heating flues. The combustion gases which escape at the bottom portion of the heating walls from the heating flues cannot, however, be utilized in this portion of the heating walls for heating the coking chambers, as their temperature is too low. In furnaces in which only each two superposed heating flues are connected together, and the waste gases from the lower heating flue escape through the upper heating flue situated directly above it, irregular coking must result. In the furnace constructed in accordance with this invention, however, the combustion gases "can be utilized in a favourable manner for heating the furnace, without affecting the uniform distillation or coking." In this case the waste gases are carried from one group of heating flues, arranged at the bottom portion of the furnace, towards a group of heating flues provided at the upper portion, "so that the fresh gases effect the necessary intenser heating at the bottom portion of the retorts, and the waste gases the correspondingly lesser heating at the upper portion of the coking chambers." In this way, it is possible "to obtain in the shortest possible working time a uniform coking of the coal with the most favourable utilization of the combustion gases, whereby the economic efficiency of the furnace is increased."

Telpher Points or Switches.

ORDISH, F. W., and ROBERT DEMPSTER AND SONS, LIMITED, of Elland.

No. 4722; Feb. 26, 1912.

The patentees claim: In track switches or points for use on telpher mono-rail and other overhead tracks, a switch bar built up of a plurality of spring plates forming the rail, which bar normally occupies an intermediate position between the two branch tracks, and is adapted to be sprung over to either side for the purpose of connecting it to one or other of such branch tracks. Their further claims are for a switch bar wherein a central plate forms or carries the track-rail; and for a switch bar wherein the several plates, or the outer plates, are connected by bolts or the like, and slotted to give freedom for sliding one on another as the curved position is assumed.

APPLICATIONS FOR LETTERS PATENT.

5845.—MILNE, J. R., and GOAD, F. L., "Gas-lamps." March 10.
5853.—ROLLASON, A., "Distillation of coal." March 10.
5871.—OTTO, E. C. F., "Gas suction pumps." March 10.
5894.—BRODIE, C. G., "Water-meter." March 10.
5931.—STIMSON, E. F., "Gas-fires." March 10.
6059.—WILTON, G. & N., "Recovering bye-products from carbonaceous or bituminous fuel." March 11.
6064.—FEDERICO, R., "Light-diffusing screens." March 11.
6101.—HELPS, G., "Gas-lamps." March 12.
6133.—FRIEDLÄNDER, H., "Safety gas-cock." March 12.
6239.—THORP, T., F., & H. T., "Incandescent gas-lamps." March 13.
6252.—HALPIN, J. A., "Producing transmission of heat from gas and air." March 13.
6262.—CARRETERO, L., "Gas producers." March 13.
6274.—BOECKEM, F. W. O., "Production of gas." March 13.
6291.—MARR, J., "Removal of ammonia from gases." March 13.
6391.—BURACZEWSKI, J., "Condensation of distillation products of crude oil and coal." March 14.
6401.—PODMORE, A. E., "Gas burners or lamps." March 14.
6454.—THOMPSON, W. P., "Inverted lamps." A communication from the General Gaslight Company. March 15.

Aylesbury Gas Company.—At the recent half-yearly general meeting of this Company, the Directors reported a balance of £1666 available for distribution; and they recommended the declaration of a dividend of 2 per cent. for the six months ended Dec. 31, less income-tax. This would absorb £1200, and leave a balance of £466 to be carried forward. There was an increase of 10·1 per cent. in the sale of gas in the half year. The Directors have reduced the price as from Jan. 1, from 3s. 9d. to 3s. 8d. per 1000 cubic feet, and to 2s. 8d. per 1000 cubic feet for power purposes. The report was adopted; and a vote of thanks was accorded to the Manager, Mr. George Lane.

Water Supply for Southbourne.—At a ratepayers' meeting at Southbourne (Sussex) on Monday last week, the question of a water supply for the district was discussed, the proposal being estimated to entail an expenditure of £10,000. There were four schemes submitted to the meeting; that known as the Woodmancot finding most favour, though the cost would mean an addition of 1s. 3d. in the pound to the present rates. Mr. Hellyer said the Portsmouth scheme would be the most economical; the mains costing £2000, and the water 9d. per 1000 gallons. It was also pointed out that the Woodmancot scheme would, if adopted, eventually become the ratepayers' property. A resolution was adopted that a protest should be sent to the Local Government Board disapproving of the scheme.

LEGAL INTELLIGENCE.

WATER CHARGES TO LICENSED CATERERS.

HIGH COURT OF JUSTICE—KING'S BENCH DIVISION.

Wednesday, March 5.

(*Before Mr. Justice* CHANNELL *and Mr. Justice* BRAY.)

Metropolitan Water Board v. Avery.

This was an appeal by Mrs. A. M. Avery, licensee of the "Crutched Friars" public-house, in John Street, Minories, against a decision of his Honour Judge Woodfall, at the Westminster County Court, in favour of the Metropolitan Water Board, in respect of a sum of 5s. claimed by the Board for two quarters' rate for water supplied for non-domestic purposes. The proceedings in the County Court were reported in the "JOURNAL" for Oct. 15, 1912 (p. 235).

Mr. W. RYDE, K.C., and Mr. E. M. KONSTAM appeared for the appellant; Mr. CLAVELL SALTER, K.C., and Mr. J. GOODLAND represented the respondents.

Mr. RYDE, in opening the case, remarked that, though the amount in dispute was small, an important point was raised. It was a test action to determine whether the Water Board could charge certain rates to licensed victuallers; and it turned on the construction of the words "water supplied for domestic purposes." The County Court Judge held that a caterer was liable to pay an extra rate for water used in his business as a non-domestic supply. The appellant was licensee of a public-house which was also used in the ordinary way as a dwelling-house. Water was supplied to the premises for domestic purposes, and the charge was based on the rateable value in the usual way. The appellant also did a small catering business for luncheons, &c.—the County Court Judge described the extent of the business as some twenty or thirty luncheons a day; and the Board contended that the use of water for preparing them, cooking, washing-up dishes, &c., was not a domestic use, and included in the valuation rate of the house. They said this was water for which they could charge at the rate of 2s. 6d. per quarter, as it was in fact a non-domestic supply. In the County Court, the defendant's Counsel challenged the Counsel appearing for the Board to point to any Statute which conferred upon them the right to make such a charge. He replied that the Board were entitled to charge by agreement for water used for non-domestic purposes; and though there was no agreement in the present case, he said he was entitled to submit that there was an implied one. The County Court Judge decided in favour of the Board that the water was not supplied for domestic purposes; but he was against them on the point as to there being an implied agreement to take water. Plaintiffs' Counsel then based his claim on the Water-Works Clauses Act, 1863, which is incorporated in the Statutes under which the charges were made—contending that the Board were acting as successors to the New River Company, whose Act was incorporated in the Act of 1863. The County Court Judge, in his judgment only, and not before, offered leave to amend, if necessary, but said he did not think any amendment was needed. The suggestion put forward by the plaintiffs was that the water used by the defendant in the way named was water used for the purposes of trade, manufacture, or business. If this was so, the water for washing the glasses and cleaning the windows would be used for trade purposes. The Counsel for the Board agreed that this would be so; but he said they did not wish to put powers in force except where there was catering. This would be a ridiculous result.

Mr. Justice CHANNELL remarked that this might be applied to any use of water where a business was carried on.

Mr. RYDE agreed, and pointed out that it would give the Board power to make very much higher charges than had been supposed. In this case, the rate would operate oppressively, because the charge for water for domestic purposes was governed by the rateable value of the premises supplied; and here this was increased by the fact that the building was a licensed house. Therefore the Board obtained an extra charge on account of the premises being licensed, and they asked for another 10s. per annum because the water was used in the public-house. He submitted that the true rule was that, if on trade premises people only used water for the purposes for which individuals would use it in private houses, it was not using it for trade purposes. It had been decided that in the case of a boarding-house the water used in the house was for domestic purposes, though it was used for and by the lodgers. Any other criterion would lead to the most ridiculous results. The same remark applied to hotels, where people used the water just as they did in their own homes. He believed the question had not yet been raised in regard to hotels. He submitted that the water in the present case was employed for domestic purposes; and that the Board had no right to impose the extra charge claimed in respect of it.

Mr. CLAVELL SALTER said the Court had to consider whether, in fact, the appellant had used the water in excess of her rights under the Board's Charges Act. His learned friend said they must look to the uses to which the water was put, and consider whether, on the proper construction of the Statutes, these uses were of a domestic kind. The County Court Judge found that the defendant carried on a restaurant business which increased the quantity of water used. She only supplied thirty lunches daily; but her contention would equally apply if she supplied three hundred. The case was of great importance to the Board as well as to the public, because there were many restaurants in which a great deal of water was used. He submitted that the rule to be applied was that laid down in the case of *Pidgeon v. Great Yarmouth Water Company*,* where it was held that the words "domestic purposes" meant where the water was supplied for the necessities of the inmates of the house—the people who were living there. The decision in that case went on the principle that the water company were not to be obliged to supply more than the normal quantity of water.

At the close of the arguments, judgment was reserved.

* See "JOURNAL," Vol. LXXVIII., p. 1390.

Monday, March 17.

Their Lordships delivered judgment to-day.

Mr. Justice BRAY, in delivering judgment, said plaintiffs sought to recover two quarters water-rate, 5s., which was claimed to be payable in addition to the ordinary rate, on the ground that some of the water supplied was used for other than domestic purposes. Defendant was the occupier and licensee of a public house which was furnished with water, in the ordinary way, by supply pipes from the Water Board's mains. The water was charged for under section 8 of their Act of 1907, as a supply for domestic purposes by a rate of 5 per cent. on the rateable value. The defendant carried on, in addition to the ordinary business of a public house, a catering business, which involved an increased use of water; and the County Court Judge held that the supply was not for domestic purposes, and that an extra rate was payable. The question turned upon the true construction of section 25 of the Board's Act, as to what was a "domestic" supply. There were plenty of businesses to which this section would apply—as brewing, dyeing, and mineral water making; and between such business purposes and domestic purposes, a clear line could be drawn. He had come to the conclusion that the water here was used for domestic purposes within the meaning of the section, and not for trade, manufacture, or business purposes.

Mr. Justice CHANNELL concurred.

The appeal was consequently allowed, with costs. Leave to appeal was granted.

PARLIAMENTARY INTELLIGENCE.

HOUSE OF LORDS.

The following progress has been made with Bills :—

Bills read a second time: Aberystwyth Corporation Bill, Bradford Corporation Bill, Broadstairs and St. Peter's Urban District Council Bill, Ebbw Vale Water Bill, Grays and Tilbury Gas Bill, Huddersfield Corporation Bill, Leicester Corporation Bill, Llantrisant Gas Bill, Metropolitan Water Board Bill, Morley Corporation Bill, Northampton Corporation Water Bill, Porthcawl and District Gas and Electricity Bill, Redcar, Coatham, Marske, and Saltburn Gas Bill, Rochford Rural District Council Bill, Slough Gas Bill, South Staffordshire Mond Gas Bill, South Staffordshire Water Bill, Tynemouth Gas Bill, United District Gas Bill, West Hampshire Water Bill, Worthing Gas Bill.

The Metropolitan Water Board Bill, Redcar, Coatham, Marske, and Saltburn Gas Bill, and Tynemouth Gas Bill have been referred to a Select Committee, consisting of Lord Balfour (Chairman), the Earl of Northesk, Lord Ramsay, Lord Blythwood, and Lord Dawnay; to meet on Monday, April 7.

The Slough Gas Bill, South Staffordshire Mond Gas Bill, South Staffordshire Water Bill, and United District Gas Bill have been referred to a Select Committee, consisting of the Earl of Plymouth (Chairman), Viscount Hood, Lord Kenyon, Lord Gwydir, and Lord Llangattock; to meet on Tuesday, April 8.

The Grays and Tilbury Gas Bill has been referred to a Select Committee, consisting of Lord Lamington (Chairman), the Earl of Harrowby, the Earl of Leicester, Viscount Iveagh, and Lord Northbourne; to meet on Wednesday, April 9.

The Ebbw Vale Water Bill, Northampton Corporation Water Bill, and Porthcawl and District Gas and Electricity Bill have been referred to a Select Committee, consisting of the Marquis of Bath (Chairman), the Earl of Londesborough, Viscount Falkland, Lord Zouche of Haryngworth, and Lord Basing; to meet on Wednesday, April 16.

HOUSE OF COMMONS.

The following progress has been made with Bills :—

Bills read a second time: Barry Urban District Council Bill, Bournemouth Gas and Water Bill, Brumby and Frodingham Urban District Council Bill, Coventry Corporation Bill, Crowborough District Gas and Electricity Bill, Derby Corporation Bill, Harrow and Stanmore Gas Bill, Herne Bay Gas and Electricity Bill, Lymm Urban District Council Bill, Mynyddislwyn Urban District Council Bill, Swanage Urban District Water Bill, Titchfield District Gas Bill, Tottenham and Edmonton Gas Bill, West Bromwich Corporation Bill, Westgate and Birchington Gas and Electricity Bill, York Corporation Bill.

The Bishop's Waltham Water Bill, Coventry Corporation Bill, Crowborough District Gas and Electricity Bill, Pontypridd and Rhondda Joint Water Board Bill, Swanage Urban District Water Bill, and Titchfield District Gas Bill have been referred to a Select Committee, consisting of Mr. Hugh Law (Chairman), Sir Cuthbert Quilter, Mr. Mount, and Mr. Ponsonby; to meet next Thursday.

The Uckfield Rural District Council have withdrawn their petition against the Heathfield and District Water Bill; and the Swanage Gas and Water Company theirs against the Swanage Urban District Water Bill.

The ninth annual meeting of Messrs. Willey and Co., Limited, was held last week, at the registered offices, Haven Road, Exeter. The Directors reported a successful year's working; and it was resolved that the usual dividend of 8 per cent. per annum be paid on the ordinary shares, and also a bonus of 2 per cent. per annum.

MISCELLANEOUS NEWS.

BRITISH GASLIGHT COMPANY, LIMITED.

Large Increase in Consumption—The National Gas Exhibition.

The Half-Yearly Meeting of the Company was held last Wednesday, at the London Offices, No. 11, George Yard, Lombard Street, E.C.—Sir CORBET WOODALL, J.P., D.Sc., M.Inst.C.E., presided, in the absence through indisposition of the Chairman, Mr. J. Horsley Palmer.

The SECRETARY (Mr. A. W. Brookes) read the notice convening the meeting; and then the Directors' report, as well as the accounts of the Norwich station. The Directors' report was as follows:

The Directors submit the half-yearly accounts of the Company to Dec. 31 last as examined and certified by the Auditors, who have also vouched for the correctness of the investments held by the Company.

The available profit is £31,194, after deducting the following sums (omitting shillings and pence): Income-tax, £2367; Hull debenture interest, £2118; Norwich debenture interest, £1779; Potteries debenture interest, £659; Trowbridge debenture interest, £164; and interest on debenture stock, £2260—total, £9349.

HULL.—The gas-rental shows an increase of £6196, as compared with that of the corresponding period of 1911; the price of gas having been the same—viz., 1s. 10d. per 1000 cubic feet. Coke exhibits an increase of £2739; tar and tar distilling, £938; and ammoniacal liquor, £98. Sulphate of ammonia shows a slight decrease, owing to a larger quantity of liquor than usual being retained in stock for conversion into sulphate in the succeeding half year. Coals have cost 12s. 11d. per ton; being the same price as for the half year to December, 1911. Coke has realized 12s. 11d. per ton, as against 11s. 4d. The gas sold shows an increase of 67,936,304 cubic feet, equal to 9·69 per cent. The quantity supplied in bulk to the Corporation for the supply of the Old Town was 46,415,000 cubic feet; being 4,250,000 cubic feet more than in the same period of 1911. The profit realized, after writing off the sum of £8500 on account of the cost of alteration and extension of works, is £7097 less than the parliamentary interest. This sum will be taken from the reserve fund; leaving £41,402 to the credit of that account.

NORWICH.—The gas-rental shows an increase of £626, as compared with that of the corresponding period of 1911; the price of gas having been the same—viz., 2s. 10d. per 1000 cubic feet, with reductions for gas used for manufacturing purposes. Coke shows an increase of £1073; and tar and ammoniacal liquor, £814. Coals have cost 16s. 2d. per ton, being the same price as for the half year to December, 1911; and coke has realized 16s. 1d. per ton, as against 15s. 8d. The gas sold shows an increase of 7,899,900 cubic feet, which is equal to 2·95 per cent. The profit realized is £759 in excess of the parliamentary interest.

POTTERIES.—The gas-rental shows a decrease of £2320, as compared with that of the corresponding period of 1911; the price of gas having been 2s. 6d. per 1000 cubic feet in the 1911 half year, whereas during the half year under consideration a rebate of 3d. per 1000 cubic feet has been allowed for prompt payment. Special rebates to large consumers and to consumers of gas for power purposes are allowed in addition to the aforesaid reduction. Coke shows an increase of £919; tar, £830; and ammoniacal liquor and sulphate of ammonia, £632. Coals have cost 12s. per ton, as against 10s. 5d. Coke has realized 10s. 6d. per ton, as against 8s. 8d. The gas sold shows a decrease of 3,174,608 cubic feet, which is equal to 1·66 per cent. The profit realized is £1265 less than the parliamentary interest.

TROWBRIDGE.—The gas-rental shows an increase of £117, as compared with that of the corresponding period of 1911; the price of gas having been the same—viz., 3s. per 1000 cubic feet, with discounts. Residual products show an increase of £345. Coals have cost 17s. 5d. per ton, as against 15s. 10d. Coke has realized 15s. 4d., as against 12s. 4d. per ton. The gas sold shows an increase of 774,303 cubic feet, which is equal to 2·09 per cent. The profit realized is £461 in excess of the parliamentary interest.

HOLYWELL.—The gas-rental shows a net increase of £81; and residual products an increase of £60. The profit realized is £652 8s.

The available profit added to the previous balance of profit and loss amounts to £105,967. From this sum the Directors recommend a dividend at the rate of 10 per cent. per annum, with a bonus of 5s. per share, both less income-tax. The dividend and bonus will amount to £31,192, and leave a balance of £74,775.

The Directors report with the deepest regret the death of their esteemed colleague, Mr. Leonard Rodwell Wilkinson, who rendered valuable services to the Company for a period of nine years. Acting under the powers of section 64 of the Regulations of the Company, the Directors will proceed to fill up the vacancy.

The CHAIRMAN said that nine years ago it fell to his lot, as it did that day, to present to the shareholders the Directors' report and statement of accounts for the half year. On that occasion he had to explain that the Chairman was absent because of a temporary breakdown of health, and that he was journeying home from a visit to Teneriffe where he had been resting. They all expressed the hope then that he would soon be restored to complete health. To-day he (Sir Corbet) had again to explain that, having had another partial breakdown, the Chairman went to Teneriffe. But he had come back no better; and so he had, much against his will, to absent himself from his customary place at their meeting. He was sure they would all join in sending to Mr. Horsley Palmer their best wishes for a speedy restoration to health. A singular coincidence, and a painful one to him (Sir Corbet), was that, on the same occasion nine years ago, the Directors had to report the decease of the late Colonel Wilkinson, who left them full of years and honours after a long period of service to the Company. On this occasion, they had to report the loss of the brilliant son who was appointed to fill his father's place, and who, though only a comparatively short time with them, had done yeoman service, and had endeared himself to all who knew him. Reviewing the half-year's operations of the Company, the fact of the most striking moment was the large increase in quantity of gas made and sold. It amounted to 74 million cubic feet, or 6·13 per cent. Each of the Company's stations had contributed to this increase, except the Potteries, where there was a falling off of 1⅞ per cent. It was a little difficult to account for this falling off at the Potteries, because trade there had been good. But the general saturation of the district with incandescent burners had, he thought, had very much to do with the slight decrease. On the other hand, Hull—the largest station—led off with a gain of 9¾ per cent. After providing for debenture interest and income-tax, there remained £31,194 for dividend purposes. As the dividend and bonus now recommended would amount to £31,193, there was left a sum of between 20s. and 30s.—rather nearer the higher than the lower figure—to be carried forward. The Company were fortunate in that, so far as the large stations of Hull and Norwich were concerned, the purchases of coal in 1911 extended over two years; and therefore, until the end of the current half year the Company would not, at these two stations, have to bear the heavy burden of the price now charged for coal. Speaking of Hull six months ago, the Chairman reported an increase of 65 million cubic feet in the sale of gas. In the past half year, they had added a further 68 million cubic feet—making 133 million cubic feet for the year. Such growth as this necessitated enlarged works, and further capital expenditure. A bench of vertical retorts, an installation of new purifiers, and several other material extensions had been made, and were fortunately brought into service before the heavy pull at Christmas time. These extensions and improvements had cost upwards of £41,000, of which about £21,000 would be charged against revenue. That was to say, while the plant installed was new, it was to a large extent in replacement of inferior plant already existing, and there must be no risk of adding to capital twice over. In June last, the Directors wrote-off £3500 from the £21,000; and in the accounts now before the shareholders, there was provision of £8500—leaving £9000, which, it was hoped, would be disposed of in the current year. The £8500 in the accounts now under consideration was met, as the report mentioned, by withdrawing £7000 from the reserve, which was practically full, and adding to this sum the £1400 which was the excess profit of the station for the half year. He had the pleasure of visiting Hull a few days since, and went over the new works with Mr. Young, the Engineer and Manager at that station. He (Sir Corbet) was able to offer his sincere congratulations not only upon the way in which the work had been done, but upon the time in which it had been accomplished; and he was glad to say that, with the work as carried out, Mr. Young was very well pleased. At Norwich they had only to report continued satisfactory work. Last year the Chairman stated that one of their officers there had completed fifty years' service; and on the present occasion it was his pleasure to report that Mr. H. P. Oakley had completed fifty years of service. Evidently service in the Company at Norwich was well worth looking after. [Laughter.] At the Yarmouth residuals works they were doubling the sulphate of ammonia plant, and should derive a proportionate profit. At the Potteries the profit realized was £1265 less than the authorized dividend. In the half year, as the report had told the shareholders, the price of gas was reduced all round practically by 3d. per 1000 cubic feet. The actual reduction in the receipts was £2320; while a reduction in price of 3d. was equal to a decrease of about £2450 in revenue. Therefore the diminution of profit was fully explained by the reduction in price. This reduction was made, not so much because the Directors felt it was absolutely due, and that the Company could afford it, but because the Corporation who had taken over the rest of the gas supply of the Potteries district were not allowed to make a profit out of their undertakings, and therefore their price had been materially reduced. He was glad to say that Holywell showed the largest profit ever recorded by that station in a similar period. Before closing these ragged remarks, he should like to mention the proposal to hold, in October next, an exhibition of the applications of gas generally. The Company had contributed its quota to the cost of the exhibition. There was so much that was new and improved in the applications of gas that, in these strenuous times, the Directors felt it was very desirable it should be brought home to the community in general; and therefore he (Sir Corbet) would commend to all those interested in gas companies other than the British to bear this in mind and see that the exhibition had the fullest measure of support. So far as the National Insurance Act was concerned, it was working quite satisfactorily at the Company's stations; and the expenses for the half year had been £364. With these observations, he moved that the report and accounts be received and adopted.

Mr. FREDERICK WILKIN seconded the motion, which was unanimously carried.

On the proposition of the CHAIRMAN, seconded by Mr. WILKIN, a dividend was declared at the rate of 20s. per share and a bonus of 5s. for the half year, both less income-tax.

Mr. RICHARD STEVENS proposed a cordial vote of thanks to the Chairman and Directors. They all regretted exceedingly the cause of the absence of the Chairman. In view of the lucid statement that Sir Corbet Woodall had made on their affairs and the balance-sheet, he (Mr. Stevens) need not say anything in support of the motion, except that it seemed to him the draft on the Hull reserve was rather heavy. But the Chairman had reassured them on that point.

Mr. KENNETH R. MACKAY seconded the motion; and it was very heartily agreed to.

The CHAIRMAN, having replied on behalf of his colleagues and himself, said with regard to the withdrawal of the £7000 from the Hull reserve fund, that, with the exception of a brief period some years ago, the Company had the lowest priced gas that they had ever supplied at Hull and, as he had said, the reserve fund was actually full. But he would ask them to bear in mind that the reserve fund was expressly for purposes of this kind—to equalize the dividend. If they had to take this amount in one lump from the earnings of a half year, they would not have been able to pay their maximum dividends; but the provision made from year to year enabled them to meet a call of this sort without risk. He might add that he had received a letter from the Chairman, expressing his great regret that he could not be at the meeting. So far as was possible, they hoped Mr. Palmer would take the longest and the fullest rest he could, in order that his valuable life might be spared to the Company and to his other work. They had also to regret the absence of Mr. R. S. Gardiner, who was detained abroad. Proceeding, the Chairman proposed a vote of thanks to the Secretary and the officers of the Company. He (Sir Corbet) had so often had occasion to say what was the estimation in which he held these gentlemen that he would not repeat himself on this occasion. The visit to Hull had given him the greatest satisfaction. The money they had spent there, and would still spend, would prove most profitable. To

Mr. Brookes they always felt deeply indebted for the extremely able and devoted way in which he at all times gave himself to the service of the Company.

Major-General W. T. Corrie seconded the motion; and it was cordially passed.

Mr. Brookes remarked that he had much pleasure in acknowledging this renewed expression of confidence in the officers of the Company. It was always very encouraging to have one's services recognized; and he was quite sure the kind words of Sir Corbet Woodall, and the manner in which they had been received by the shareholders, would be a stimulus to further efforts on the part not only of the officers, but of their staffs and the workmen as well. They would all most thoroughly appreciate the compliment paid to them.

TWENTY YEARS' PROGRESS AT TORQUAY.

The Annual Meeting of the Torquay Gas Company was held on Monday last week—Mr. R. P. Kitson (the Chairman) presiding.

The Directors' report showed that the balance to the credit of the profit and loss account was £12,894; and payment of the statutory dividends of 7 and 10 per cent. was recommended.

The Chairman, after referring to the loss during the year of Mr. W. B Beynon, who was a Director of the Company for 41 years, and by his technical knowledge had rendered great service, said the past year had been a satisfactory one to the Company. The sales of gas amounted to 197,239,700 cubic feet, compared with 188,784,300 cubic feet in 1911—an increase of 8,455,400 cubic feet. This increase was most remarkable when they considered the competition which existed. It was brought about largely by the greater demand for gas for cooking and heating purposes. The coal strike and the higher price of coal led the public to appreciate the cheapness and convenience of gas for these purposes as well as for illumination. During the year, 243 additional cooking-stoves were sent out on hire by the Company; and the total number now in use was 3000. They had also fixed 147 new gas-fires; and 53 geysers, circulators, and grillers were sold to consumers. A sum of £341 had been distributed in bonus to the employees and staff, in recognition of the loyalty of all grades. The revenue from the sale of gas was £26,117, compared with £25,433 the previous year. The increase of £684 was a most satisfactory amount, considering that there had been a reduction in the price of gas. The total sum to the credit of the revenue account was £36,680—an increase of £1270; and the balance carried to the profit and loss account was £7859, against £7866. Coal had cost 16s. 8·03d. per ton last year, compared with 16s. 5·7738d. in 1911; the increase being due to the strike. Residuals had yielded a good return.

Mr. A. Iredale, contrasting the position of the Company now with what it was twenty years ago, said the capital had been increased from £85,000 to £116,253. The quantity of coal carbonized in 1892 was 12,948 tons, while last year it was 14,243 tons; and, in addition, they used 141,066 gallons of oil. The price of gas had been reduced from 3s. 3d. to 2s. 8d. per 1000 cubic feet, while the cost of coal had advanced from 13s. 4½d. to 16s. 6d. per ton. To-day the Company were in a sounder and better financial position than ever they had been before.

In reply to a question, the Engineer (Mr. R. Beynon) said the unaccounted-for gas was 4·3 per cent.

The Chairman remarked that there had been a wonderful improvement in this matter.

The report and accounts were adopted, and the dividends recommended were declared.

OTTOMAN GAS COMPANY, LIMITED.

Smyrna and the War.

The Ordinary General Meeting of the Company was held on Tuesday last, at the London Offices, Nos. 59 and 60, Gracechurch Street, E.C., Colonel Stephenson R. Clarke, C.B., in the chair.

The Secretary (Mr. A. W. Cooper) read the notice convening the meeting, and the Auditors' certificate; and the report and the statement of accounts were taken as read.

The Chairman, in moving the adoption of the report and accounts, said the shareholders would readily guess that the half year the Company had passed through had been an especially anxious time for the Directors. The price of coal had been an anxiety to many gas companies; but the Ottoman Gas Company had a worse anxiety—that was, they were afraid that they would be unable to obtain any at all, the Greek Government having declared coal to be a contraband of war. Fortunately, however, after some difficulty, they courteously permitted a few cargoes to be sent to the gas-works; and the grateful thanks of the Company were due to them for this, as well as to the English Foreign Office, through whose intervention the necessary permission was obtained. With the dislocation of business owing to the war, the Board naturally expected that the sales of gas would, if not actually showing a decrease, at any rate exhibit a check on the increases that the Company had been for many years accustomed to. However, he was pleased to say that the rate of increase as regarded gas was about 12 per cent., which, under the circumstances, certainly left no cause for complaint. There had also been an increase in the sales of products of nearly £1000. The two together had helped them considerably to face the extra cost of coal, which had risen to £11,765 for the half year, as against £7739 for the corresponding half of the previous year. The item of renewals and repairs again ran into a big figure; and owing to some heavy expenses that would be necessary for retorts, this must be expected to continue high during the next two or three half years. After all was finished, there was the sum of £3645 as net profit, compared with £5878. This enabled them to maintain their dividend without encroaching on the reserve. In conclusion, the shareholders would be interested and pleased to hear that, should the war end now, the prospects of Smyrna appeared favourable. A large number of Turks from Europe had migrated to the country behind the town, and a great increase in the land under tillage was reported as a consequence. The Company, though they would probably feel some check during the present half year, should ultimately share in this. He hoped that long before the Directors met the shareholders again peace would have been declared, and the anxiety that war brought in its train would have passed away.

Mr. A. M. Paddon seconded the resolution, and it was at once unanimously carried.

On the proposition of the Chairman, seconded by Mr. Strachan C. Clarke, dividends for the half year were declared at the rate of 7 per cent. per annum on the preference shares, less income-tax, and at the rate of 10 per cent. per annum on the ordinary shares.

The retiring Directors (Colonel James Le Geyt Daniell and Mr. H. Ward Andrews) were re-elected, on the motion of the Chairman, seconded by Mr. Clarke; and the Auditors (Messrs. T. H. Cooke and F. W. Church) were re-appointed, on the proposition of Mr. T. Wilkins, seconded by Mr. F. C. Collingwood.

The Chairman moved a vote of thanks to the Engineer and Manager (Mr. John Gandon), the Consulting Engineer (Mr. A. F Phillips), the Secretary, and the staff in England and Smyrna. He said he had already had occasion to allude to the difficult times the Company had gone through during the half year; and these anxieties, great as they had been to the Board, must have been a still greater strain on those who were out in Smyrna, with the trouble and worry of war all around them. He felt that the Company had, considering all things, enjoyed a particularly fortunate half year; and they were much indebted to those who had so ably assisted them to secure these good results—especially to Mr. Gandon and Mr. Cooper.

Mr. Paddon seconded, and remarked that the duty of every servant of the Company had been abnormally difficult during the period under review; but it was satisfactory to note that the horizon appeared to be somewhat lighter, and they hoped that the troubles would have disappeared before the close of another half year.

The resolution was heartily carried, and acknowledged by Mr. Cooper and Mr. Phillips.

Mr. A. W. Oke proposed a vote of thanks to the Board, and spoke appreciatively of the policy which had enabled them to present such an excellent balance-sheet. It was, he said, gratifying to see that there was every prospect of the present dividend of 10 per cent. being maintained.

The resolution was seconded by Mr. Wilkins, and carried.

The Chairman, in reply, said they had certainly had a more anxious time than usual; but, on the whole, things had come out a great deal better than they expected. He hoped they might have an equally good report to lay before the shareholders at the end of the present half year; but just now the export of grain from Smyrna had been prohibited, and this was having an adverse effect on the trade of the port, which would probably react upon the Company. However, nothing very serious had occurred so far.

DAVIS GAS-STOVE COMPANY, LIMITED.

Presiding at the Thirteenth Annual Meeting of this Company, which was held last Tuesday, at the Cannon Street Hotel, E.C.,

The Chairman (Mr. H. Addis Price) alluded to the loss they had sustained by the death of the late Chairman, Mr. Henry J. Davis, and said he was sure the shareholders would join in the feeling of regret that Mr. Davis was no longer there to preside over the meetings. He was working absolutely to his last moment in the interests of the Company, which practically owed its existence to his foresight, and above all to his unswerving belief in the potentialities of the gas-stove industry. Another matter he had to refer to was the resignation of Mr. C. S. Barber of his position as Director. Mr. Barber resigned his secretarial duties on Jan. 1 last; and his health was very bad, and he now wished to vacate his seat at the Board as well. All present knew how he had worked for the Company. He also regretted to inform them that Mr. J. Spiers Aitken, their Foundry Manager at Luton (who joined the Company when they purchased the Langley Foundry) had asked to be allowed to be relieved of his duties because of advancing years. He had for some weeks been very ill. Referring to the report [which was noticed in the "Journal" last week, p. 783], he said he was sure the shareholders would agree that the results of the past year's trading were in every way eminently satisfactory. They had had to contend with very high prices for raw materials; and though there had been a rise in the price of their goods, the profit in some instances would have been considerably reduced but for the fact that the Directors had to some extent bought forward their raw materials. The past year had been a record one, both for turnover and profit. In conclusion, he paid a tribute to the valuable work being done by the British Commercial Gas Association.

Mr. Cyril G. Davis, in seconding the motion, said the policy the Board had adopted had been of a very progressive nature; and they had not been afraid of spending money judiciously to develop the business. They had made many important additions to the Luton works; and he had no hesitation in saying there was no finer or better-equipped works in the country. The technical department—which had a very important bearing on the production of the various goods the Company marketed—had received very close attention. They had a staff of highly-trained scientific men devoting their whole energies to this branch of the business. The laboratories were kept thoroughly up-to-date in every way. The work in this connection had already proved of great value to the Company. It had enabled them to place upon the market the very best type of apparatus, which had done a good deal towards bringing about the enormously-increased demand of the past year. The Company were one of the first firms to devote their attention to the perfecting of gas water-heaters; and they were convinced that there was a big future for this branch of the business. They had worked on lines entirely their own, and had met with great success; and they were still pursuing some important development work in this connection. Their gas-heated steamless radiator, too, was an ever-increasing business. They were probably the only firm who guaranteed

their radiator, and yet they had not at any time been called upon to effect any replacement or repair under their guarantee.

MODERN GAS-FIRES AND THE "SHADOWGRAPH TEST."

The Company had long felt there was a considerable amount of work to be done in improving the hygienic efficiency of the modern gas-fire; and he did not hesitate to say that they had given a considerable lead to the gas-fire industry. Some two seasons ago, they placed upon the market a series of gas-fires which they had proved to be hygienically perfect—that was to say, a series of gas-fires capable of passing the whole of their products up the chimney unaided by any chimney draught or flue-pipe. The Directors had never been able to discover why gas undertakings should be called upon to provide anything from 2 to 10 feet of flue-pipe to remedy the defects of gas-fires which were not hygienically perfect when delivered. Not content with producing a series of fires of this description, they had also been in the fortunate position of introducing a very simple, but most effective, means of testing gas-fires for their hygienic efficiency. He referred to the "Davis Shadowgraph Test." Several large gas undertakings, not only in England and Scotland, but also in America, had adopted this as their standard test; and, in addition, many gas undertakings in this country had intimated their intention of purchasing in the future only fires that would pass the "Shadowgraph" test. The Company had adopted a very broad-minded policy in relation to this important subject of hygienic efficiency. Many of those interested in the manufacture of gas-fires had had the opportunity of seeing their own fires under this test; and he had no doubt there would be a general improvement in the construction of gas-fires during next season, which would be the outcome of the policy inaugurated by their Company.

THE PUBLICITY CAMPAIGN.

Apart from the work the Company had done, he would like to call attention to a very important body formed some twelve months ago under the title of the British Commercial Gas Association, the object of which was to awaken the public mind to the many advantages possessed by gas as a fuel for household and trade purposes. There was no doubt whatever that this organization had given them considerable assistance during the last year, and that in the near future the gas undertakings not subscribing to the Association would be in a minority. Success was, indeed, stamped upon the Association in its early childhood. He also wished to take the opportunity of mentioning the great assistance they had received from the publicity campaign which the South Metropolitan Gas Company had so energetically followed up in London. Indeed, gas companies were every day improving their selling methods, which fact must be of great help to those who were interested in the sale of gas apparatus.

THE NATIONAL GAS EXHIBITION.

Another very important matter to which he would like to draw their attention was the National Gas Exhibition, which was to be held at Shepherd's Bush in October of this year. The exhibition was going to be on a scale never previously attempted in connection with the gas industry; and he was convinced that, when the public had had an opportunity of visiting the exhibition, they would go away with their minds made up that gas had many advantages which would be useful to them, and of which they had been entirely ignorant in the past. He need hardly say that this object, if achieved, would again have an important bearing on the popularization of gas appliances. Both in regard to the British Commercial Gas Association and the National Gas Exhibition, the two sides of the industry (the gas engineering side and the gas apparatus manufacturers) had co-operated in the heartiest possible manner with one common object—namely, the welfare of the whole gas industry.

The report was adopted (including a dividend on the ordinary shares at the rate of 15 per cent. per annum for the past half year, making 10 per cent. for the year); and, on the proposition of Mr. HAROLD N. DAVIS, Mr. Addis Price was re-elected a Director.

FLETCHER, RUSSELL, AND CO., LIMITED.

The report of the Directors [noticed in the "JOURNAL" for the 11th inst., p. 706] was adopted at the twenty-first annual meeting of the Company, held last Wednesday in Warrington. In submitting it, Mr. George Perkins, who presided, said he thought the shareholders might congratulate themselves on the result of the year's working, as there was sufficient evidence in the balance-sheet to show that there had been a steady improvement in the position of the Company, financially and otherwise. A much larger business had been done, owing to some extent to the coal strike; and this, coupled with the many economies which had been effected, accounted for the satisfactory results achieved. Before arriving at the profit shown in the accounts, large depreciations had been allowed for, which were absolutely necessary to a sound financial condition of the Company. He then dealt with the figures given in the report—pointing out that the balance (after charging depreciation) from trading account, interest on investments, &c., amounted to £22,102. After paying the dividend on the preference shares, the Directors recommended a dividend of 5 per cent. on the ordinary shares for the year, and a bonus of 2½ per cent., leaving a balance of £3057 to be carried forward. Continuing, he remarked that the arrangement made by the Directors, reported at the last meeting, to provide a fund to meet compensation cases for accidents, was still working satisfactorily. The National Insurance Act had given the Company a great deal of extra clerical work to do; and though they had only had a few months' working of the Act, they could see that the expense of it practically meant a loss of 1 per cent. dividend to the shareholders. The labour question was still causing them some trouble. They had, along with other makers, had this year to give a further increase of wages to all workmen; and this, of course, was a further charge against the profits. They secured advances on the prices of their goods last year, which were still being maintained, in order to cover the increase in wages and the higher cost of all materials. The Board desired to express the great loss the Company had sustained by the death of Mr. Bowers, the late Manager of the works; and they also tendered their thanks to the Secretary and staff for their devoted and arduous services during a very strenuous and trying year.

Mr. E. Rowson seconded, and said the Chairman, in his speech twelve months ago, expressed the hope that they would have a prosperous year; and it was a great pleasure to find his hopes had been realized to an extent that he personally did not expect. The labour question had been referred to; and it seemed to him a strange thing that the trade unions, on every possible occasion, should offer opposition to the employer; and instead of working hand in hand for the good of the country, the employers, and the employees, they appeared to fly in the face of the employers. He thought that what was good for the employer was good for the employee; and the best motto they could adopt was "One for all, and all for one."

A payment was voted to the ordinary Directors (other than Managing-Directors) as extra remuneration, the amount of this to be left to the Board to determine; and the retiring Directors were re-elected.

THE ILKESTON GASHOLDER DISASTER.

In another part of the "JOURNAL" will be found, practically in its entirety, the report of Mr. A. G. Drury, M.Inst.C.E., the Inspector who conducted the inquiry into the circumstances connected with the accident to the spiral-guided holder at the Ilkeston Gas-Works early last year; and the report is dealt with in our editorial columns. In view of the importance of the subject-matter of the inquiry, it may not be uninteresting to give the following observations upon it, written by a correspondent who had the advantage of being present during the whole proceedings.

Although an unconscionably long period has been allowed to elapse between the holding of the inquiry into the circumstances connected with the Ilkeston gasholder disaster and the publication of the official report in relation to the matter, keen interest has been revived by the opportunity which has been afforded within the last few days of considering the conclusions arrived at by Mr. A. G. Drury, M.Inst.C.E., one of the Engineering Inspectors of the Local Government Board, who, acting under the instructions of the Home Secretary, in consonance with the provisions of the Factory and Workshops Act, conducted the investigation, extending over two days in June and one day in July last, into the causes of the occurrence. While those responsible for the conduct of Ilkeston affairs may possibly by this time have heard more than enough of the maladministration in relation to the Corporation undertaking, Mr. Drury's report, albeit somewhat belated, arrives at a particularly opportune juncture, when a more than ordinarily fierce light is beating upon the action of the Gas Committee. The recent examinations by other Government Inspectors of the circumstances connected with the original loan for the works in 1908 revealed some inexplicable incidents as to radical departure from plans at first decided upon; and while Mr. Drury's work had no bearing upon the process of "hoodwinking" the Government Department, to which strong prominence has been lately given, his report is significant as allocating technically the cause of the trouble to the weakness of the above-ground steel tank, the substitution of which for the brick and puddle tank originally proposed has led the Corporation into the dilemma of which it has not, by any means, yet heard the last from the central authorities.

The inquiry succeeding the *débacle* that occurred on the 8th of January of last year was regarded by some as temporarily placing the safety of spiral-guided holders in doubt; but whatever misconception at the time may have prevailed in the lay mind upon the point was speedily removed by the scientific evidence. The inherent weakness of the tank was the point to which attention was mainly directed at the investigation; and that the factor of safety allowed for did not err on the side of liberality was evidenced then, as it is now made increasingly apparent by Mr. Drury's report. He finds, as the volume of evidence left no doubt would be the case, that "had the tank not been structurally weak, the result of such an occurrence as the temporary jamming of the holder on the unsealing of a lift would probably have been confined to a loss of gas and damage to the holder itself." His pertinent observation as to the employment of steel tanks above ground for gasholders, even of the spiral-guided type, that nothing he has seen or heard leads him to condemn their use, provided they are properly designed, constructed, and maintained, is in keeping with the evidence which was given by Mr. J. Ferguson Bell, who pointed out that of late years, if they took a hundred gasholders, they found that no fewer than eighty had steel tanks. It may be recalled that the capacity of the tank in this instance was 1,600,000 gallons; and it was notable that there was no evidence of recent subsidence. The reason for the substitution of the steel tank in place of the brick and puddle one originally proposed was, according to the evidence of Mr. F. C. Humphrys, the Corporation Gas Engineer, the opinion that it was more suitable in a mining district such as that in which Ilkeston was situated. It was elicited also that the Committee were confirmed in this view after visiting other districts where steel tanks are in use. That some extraordinary strain was thrown upon the tank at the moment of the accident was made clear by the testimony of Mr. Samuel Glover, who was called in immediately after the accident, in conjunction with Mr. Bell, to advise the Corporation.

Under the tensile test applied at the Whitworth Institute, Manchester, to portions of the steel taken from the demolished tank, the behaviour of the material was quite good—withstanding as it did a strain of upwards of 27 tons per square inch. Mr. Glover's declaration was that it seemed to him that the plates justified their use; and in regard to the contract, which was carried out by Messrs. C. & W. Walker, Limited, while expressing his desire to be very careful in the matter, he frankly added that he should very likely have done exactly as Mr. Humphrys and the Gas Committee did, had the tender been submitted to him at the price it was by the Shropshire firm. Mr. Glover and others emphasized the consideration that the factor of

safety ought not to be less than 4, though the evidence of Mr. Bell pointed to the conclusion that the factor of safety on the bottom plate was 3·4. Mr. Bell participated, however, in the opinion that there was no fault to be found with the material, which was Bessemer basic steel, so far as tensile strength went; but Mr. Drury, while sharing the view that in such cases there should be provided a factor of safety of at least 4, is emphatic in his pronouncement that among the lessons to be learnt from the disaster are these—that the use of Bessemer basic steel for such important structures should be avoided, and that the British standard specification for structural steel for bridges and general building construction should be universally adopted. Professor Adams, who gave evidence for the Contractors, said at the inquiry that though, if the design had been submitted to him and he had been asked if he thought it was a good one, he could not have found fault with it, yet he might have made a little alteration as to the bottom of the tank. The impression generally left by the technical evidence was that considerations erred rather on the side of cheapness.

As all who followed carefully the evidence given at the inquiry may have anticipated, the salient deduction emphasized by Mr. Drury is that in such cases a safety factor of at least 4 should be provided; while the Ilkeston experience regarding the exposed situation of the tank and the proximity of buildings lends strength to his suggestion that there are special circumstances, such as clearly obtained in this instance, in which it might be reasonable to employ a factor in excess of this figure. The trend of the professional evidence available at the investigation was also entirely in accord with the opinion now expressed by the Inspector that, for a spiral-guided holder, a more generous factor should be allowed than in a tank for a standard holder, which, for the most part, is subject only to the static pressure of the water. But in regard to the margin of safety, as the experience proved, the allowance was no more "generous" than has been the recent treatment by the Corporation of one of its oldest officials, who has been vicariously allowed to bear the brunt of responsibility for a change of plans for which alone the Committee concerned were responsible.

In the light of that which transpired at the inquiry, little surprise will be occasioned at the Inspector's unequivocally expressed opinion that the Town Council were somewhat ill-advised in not calling in a specially skilled engineer to assist them in the choice of a design, and that the initial mistake was made in accepting without question a specification and design from manufacturers in competition with other firms. Testimony was forthcoming as to the excellence of Messrs. Walker's work; but there was the admission from Mr. Humphrys that, in connection with the contract, there was no stipulation as to the working stress placed upon the metal. This was left entirely to the Contractors; the tests being made by them and forwarded to the Corporation's Engineer. Mr. Humphrys, indeed, confessed that he was not himself able to express any opinion as to the working stress of the material in the tank. He did not know whether the stress was heavy or light, not having gone into the matter beforehand. Contracts, it may be recalled, were not advertised for; but five firms were invited to tender—these being Clayton, Son, and Co., Westwood and Wrights, Newton, Chambers, and Co., R. & J. Dempster, and C. & W. Walker. The price submitted by the last-named firm for the holder and tank was the lowest—£5086; the next, Dempster's, being £5300; and the highest, that of Clayton, £6032 for the whole work. The two others were £5700 each.

Mr. Drury is unsparing in his condemnation of the practice, which has come increasingly into vogue in recent years, of accepting without question a specification and design from a manufacturer in competition with other firms. It will be noticed that he agrees that there is nothing to be said against, but a good deal in favour of, inviting firms who make a speciality of certain work to submit prices and their own designs. The mistake made by the Ilkeston authorities, however, lay in their failure to have independent examination of the plates and bars before work was commenced upon them. But the neglect to engage a consulting engineer of standing and repute was in keeping with the false economy which characterized the Corporation procedure at other stages of the work, and particularly that leading to the substitution of the above-ground tank, which was practically the whole cause of the mischief. While the disaster has not been without its useful lessons upon the technical score, it has afforded another illustration, if one were needed, of the fatuity of corporation processes which aim at cheapness to the exclusion of sound structural methods.

A reflection of the feeling which was manifested at the inquiry at the cheeseparing policy of the Council, as illustrated by the failure to call in a specially skilled engineer to advise them in the choice of a design, is evident in the unsparing condemnation of the Inspector, whose observations as to the mistaken idea of economy thereby involved might well serve as a text for general connotation. Indeed, Mr. Drury's sententious strictures upon this point merit a prominent place among local government or other departmental *obiter dicta*. It is not a case of Ilkeston alone, but of the whole realm of professional work; and the catastrophe which occurred in the Derbyshire borough, unpleasant though some of the disclosures resulting from it have been, would have served an eminently useful purpose, if for no other reason than that it has elicited from the accredited representative of the Home Office the following pronouncement, which obviously applies more particularly to the smaller municipal authorities of which Ilkeston is a type: "It is too often the case that public and other bodies, with a mistaken idea of economy, elect to dispense with the services of a qualified adviser because, not only do they grudge his fee, but they fear that, as a result of such action, they might be compelled, against their inclinations, to adopt more substantial and costly works. But there is little room for doubt that in the long run, and in the interests of all concerned, it is the best and cheapest policy; and it has been amply exemplified in the present instance." The sentence is so significant that it might, with possible advantage, be framed and glazed and hung up for inspection in places where all small gas committees congregate.

The Ellwhite Gas-Stove Company, Limited, has been registered with a capital of £6000, in £1 shares; the Ramsay Gas Flashomoter, Limited, with £1000, in 1s. shares; and the Rio Grandeuse Light and Power Company, Limited, with £100,000, in £1 shares.

THE DEL MONTE PROCESS.

Mr. F. D. Marshall and the "Hands of Amateurs."

In last week's issue, portions of Mr. W. J. A. Butterfield's report on the Del Monte low-temperature carbonization process were published, together with an editorial comment. Mr. F. D. Marshall, in a letter to the "Car," indulges in some facetious remarks on the process; and then, in a more serious frame of mind, he proceeds:

To turn to the mechanical side of the Del Monte process, we find that the retorts (cast iron) are vertical and circular in section, and that it takes over eight to ten hours, at a temperature of 800° Fahr., to *partially carbonize* the core of the coal, which (*vide* Mr. Butterfield) is left in a pasty or uncarbonized condition. Just so. Mr. del Monte, &c., &c., is beginning in this respect where experienced gas engineers have left off, because even at 2000° Fahr. it is difficult, very difficult, in a circular sectioned retort to carbonize the core of the charge until long after the outer layers of coal in contact with the inner periphery of the heated retort are over-carbonized, and the effluent gases practically destroyed.

The outer *over-carbonized* edge of the coal produces naphthalene and pitch (corroborated by Mr. Butterfield); while the good gases from the lesser heated coal core are forced to the over-heated edge and destroyed—at least, so far as the valuable oil-giving hydrocarbons are concerned. *Ergo*, Mr. del Monte has pitched upon the wrong-shaped retort. But it is not my business, a simple student of these matters, to enlighten him as to a better form.

We now come to the *crux* of the patent claim—viz., the passing into the retort of an inert gas, preferably coal gas, after being heated by passing in a coil (inside the furnace) around the retort. This introduced gas is ostensibly to act as a "picker-up" of stray and wayward hydrocarbons, which would otherwise refuse to emerge from the mother coal in a pristine and oil-condensate-giving condition. Now, these goody-goody hydrocarbons must be lurking in the core of the coal, as those in the outer circles departed at the commencement of operations. But, according to Mr. Butterfield, the introduced gas does not attack the core at all, but passes out uselessly between the sides of the retorts and the charge!

If it is Mr. del Monte's intention that this preheated gas shall pass up through the *core of the coal*, and so convey the necessary heat to carbonize the core at an equal speed as the periphery is carbonized, I am reluctantly compelled to think he has made a mistake. The non-passage of the introduced gas through the core of the coal is admitted by Mr. Butterfield, as stated above. Therefore it appears that the patent claims of the benefits of passing a preheated inert gas through the charge of coal are of no value either as a "picker-up" of other hydrocarbons or as an aid to the carbonizing of the coal core.

When the process is boiled down, it comes to nothing but an ordinary, very ordinary, system of low-temperature carbonization following—a long way behind—in the footsteps of coalite.

What are the results compared with a good and known standard low-temperature process? Simply these:

	Del Monte.		Standard Process.
Duration of run	8 to 9¼ hours	..	3 hours
Tar oils extracted	14·5 gallons	..	18·20 gallons
Percentage of coke	63 to 80·4	..	75 to 80

As regards the yield of ammonia, this can only depend on the amount of nitrogen in the coal carbonized; and *no* low-temperature process is going to give much better results than those obtained from any gas or coke-oven works—from 20 to 28 lbs. of sulphate per ton of coal at the maximum.

The anticipation of reading Mr. Butterfield's report on the Del Monte process in your esteemed "Car" filled me not only with avidity, but with positive greed for knowledge; and I felt sure that I was to sit at the feet of Gamaliel and learn. But I am sadly afraid that I have only fallen into the hands of amateurs, and must seek a solution of the "Benzol from Coal" problem elsewhere.

GAS FOR FURNACE WORK AND POWER.

Sheffield Experiences.

In their issue for Wednesday last, the "Sheffield Daily Telegraph" related the experiences of a number of Sheffield manufacturers who are large consumers of gas for heat and power purposes. From the opinions expressed, it is evident that careful consideration is being given to the question of furnace heating, and that the advantages of gas are widely realized, though the first managing-director interviewed pointed out that there are certain classes of steel that cannot be manipulated without making a considerable quantity of black smoke. The results of other interviews our contemporary reports as follows.

The chief engineer of one of the largest east-end concerns, whose qualification to speak quite impartially as to the relative merits of gas and electricity is sufficiently indicated by the fact that his firm pay about £3000 per annum to the Gas Company and about £3500 to the Corporation for current, expressed entire satisfaction with the working of the gas-furnaces they have installed. Their two large annealing furnaces work very well, though their chief recommendation is not so much the more economical working so far as the cost of fuel is concerned, but the fact that gas-furnaces are under so much better control. This firm have also another furnace for the heat treatment of steel, to which the same remarks apply, and have just installed lead-pots for hardening files and various tools, of the success of which it is yet too early to speak. The firm are so satisfied with the gas-furnaces that they contemplate extending this plant. Their gas-heated drying stove has been found quite as economical as solid fuel firing, and is, of course, under much better control. The firm also use gas extensively in heating for hardening

high-speed and ordinary carbon steel. Gas for power purposes is likewise used very largely at these works.

Mr. S. Warren, who was the first steel manufacturer in Sheffield to instal gas-furnaces, enthusiastically pronounced them "the best furnaces for annealing of which I have experience. They are undoubtedly the most economical, and much quicker. I can anneal every day, while with most other furnaces it would be possible to do so only every other day, or in some cases every third day. With a furnace that cost me £140, I can anneal 2 tons a day. I am melting steel with coke now; but if I had to put down another furnace, it would be a gas one. It is not only much more economical, but so much cleaner. There is a natural draught, and no smoke, and you can muffle your head; you do not want the heat on the roof."

Testimony as to the value of gas for power purposes in a rolling-mill was readily furnished by Mr. George Clark. At his Penistone Road mill, he has gas-engines of 300, 150, 45, and 25 H.P.; and while admitting the slightly greater convenience of electric power, Mr. Clark's experience satisfies him that, when its far greater cheapness is taken into account, gas power has an unquestioned supremacy. A few years ago, he went closely into the comparative costs, and found that gas would cost only about one-third as much as electric current, notwithstanding the fact that to a very few large consumers it is supplied at so exceptionally low a figure as about ½d. per unit. Mr. Clark is using about 400,000 cubic feet of gas per week, and finds he can run his 150 H.P. engine for 18 hours a day at a cost of £4 10s. per week. Two 150 H.P. engines coupled drive a 40-ton fly-wheel 30 feet in diameter night and day.

HINTS TO GAS CONSUMERS.

Lecture by Mr. W. B. M'Lusky.

In the room of the Literary and Philosophical Society in connection with the Halifax Scientific Society, Mr. W. B. M'Lusky, the Corporation Gas Engineer, recently gave a lecture on "Conditions Affecting Combustion in Gas-Flames," in the course of which he threw out some useful hints to gas consumers. Commenting on the influence of pressure on various burners, he pointed out that the most economical results could only be brought about by the burners being selected with due regard not only to the pressure at the house, but also to the particular size of pipe. He, however, emphasized the fact that, from the consumers' point of view, pressure was the most important part of all. In Halifax, the pressure was right in all parts of the town. The consumer must learn to control it according to his own needs. He pointed out the value of gas-governors, adjusters, and so on. Every burner, he said, was made for a definite shape of flame and pre-determined consumption of gas; and unless these two were obtained there was something wrong. Referring to incandescent burners, the lecturer said that, having obtained the highest efficiency, some people were at a loss to know how to maintain it. The burner should be taken off about once a month and blown through to remove the dust. There should be no trouble with the mantles, which could be taken off a dozen times without breaking. The mantle should be taken off with a pencil or something similar, which should be passed through the loop at the top, and then placed upon the edges of a tumbler with the mantle hanging inside the glass. Turning to gas rings and stoves, Mr. M'Lusky said the flames should never rise above the level of the utensil, and they should not come up over the side. By allowing them to do so, a nasty odour was caused. A flame which surrounded the vessel boiled a kettle more quickly than one which did not; but it did so at a very great increase in the quantity of gas consumed. The question for the consumer was the amount of gas consumed to boil a given quantity of water. It was better in every case to wait a minute longer for a pan of water to boil than to waste 40 per cent. of gas consumed in order to save a minute. Mr. M'Lusky illustrated his lecture by practical demonstrations, which enabled his audience to appreciate the various points brought forward.

PROPOSED EXTENSION OF THE SEDGLEY GAS-WORKS.

A Local Government Board inquiry concerning some proposed extensions of the Sedgley Gas-Works was conducted on Thursday, by Mr. M. K. North. The inquiry was held into an application by the District Council to borrow £5600.

Mr. T. B. Knight (Clerk) explained that the present annual output of the gas-works was 40 million cubic feet, which was the maximum. It was now contemplated to demolish the retort-house and bench, coal-stores, and manager's house, and to provide five settings—three to be completed forthwith, and two for future extension—with six retorts to each, at a cost of £2195. The estimated capacity of the three settings was 43 million cubic feet per annum, on a basis of 12,000 cubic feet per retort per day; but it was believed that, having regard to the quality of the coal now being used, this figure would be considerably increased. It was also proposed to provide a new retort-house, at a cost of £975; mechanical coal-handling plant, engine, dynamos, and motors, £1005; charging and discharging machines, £775; coal-stores, £500; and exhauster, £150. Of the old loan on the gas undertaking, raised in 1883, there was now outstanding a final instalment of only £556, which would become due in May next. The present charge for gas in the district was 3s. per 1000 cubic feet by ordinary meter, and 3s. 7½d. by slot meter. The new works would be erected on the present site, consisting of freehold land belonging to the Council.

The Gas Manager (Mr. J. Brettle) gave particulars of the new plant; and at the conclusion of the inquiry, the Inspector visited the site of the proposed extensions.

The gas-works at Rueil, a small town about five miles west of Paris, were damaged by a fire which occurred on the 15th inst. Under the ruins were found the bodies of the *concierge* and his child.

WEST BROMWICH GAS UNDERTAKING.

Allocating Profits in Relief of the Rates.

The West Bromwich Town Council, at a special meeting last Tuesday, accepted an offer of the Gas Committee to give out of their profits £500 in relief of the rates. During a discussion on the subject, Mr. W. Lawley mentioned that the Electricity Committee were also assisting the rates from their profits to the extent of £200; but he thought trading concerns which had cost the town £450,000 should be able to hand over more than £700 towards the rates. Mr. J. Brockhouse (the Chairman of the Gas Committee), in reply, said twelve months ago they decided to reduce the price of gas, with the idea of popularizing it. With regard to the Committee making a larger grant in relief of the rates, there had unfortunately always been a difference of opinion on this matter. If he had his way, there would be no grant at all, because he believed it was part of a great evil, and it was not right for them to expect these annual grants from their trading concerns. They had handed over for the rates sums varying from £500 to £2000; and at the very commencement of the gas undertaking, and before it was on a firm footing, for several years they granted £3000 a year. He did not think that was a wise policy to adopt, and it was certainly not good finance; for they were actually assisting the rates out of the capital instead of out of the profits. On a capital of £241,000, a profit of about £4000 was not satisfactory. The Committee were taking steps to reorganize their works; and he hoped that in a few years' time they would be able, instead of making a paltry £4000 profit, to see one of £8000 or £9000. Then they could begin to talk about handing over to the rates £3000 or £4000 a year; but until then they must hold their hands. It was good policy on the part of the Committee to be careful, and nurse their funds. The Mayor (Mr. J. A. Kenrick) said the policy of allowing for depreciation and building-up a good reserve fund was the only sound one the Committee could adopt. When the gas undertaking first became a municipal concern, it was a very great pity they bled it to the extent they did, as the concern had suffered from that ever since.

LEWISHAM WORKHOUSE AND INFIRMARY LIGHTING.

At the last Meeting of the Lewisham Board of Guardians, they sat in Committee to consider the tenders from the South Metropolitan Gas Company and the South Metropolitan Electric Light and Power Company for supplying electricity to the Workhouse and Infirmary. No official information was given to the Press, but it is understood that the Gas Company adhered to the terms already offered by them—viz., 2d. per Board of Trade unit for light and 1½d. for power. The Electric Light Company's terms were now precisely the same; whereas previously in the case of the Infirmary the price suggested by them for light was 3d. per unit. There was much discussion; but it was decided by a small majority to accept the Electric Light Company's tender. The matter will, however, again come up at the next meeting of the Board.

The following comment on the subject appeared in the "Kentish Mercury" last Thursday:

The Lewisham Union Board of Guardians met last Friday in committee, and—so we learn—decided to accept the tender of the South Metropolitan Electric Light Company to supply electricity to the Workhouse and Infirmary at 2d. per unit for light and 1½d. for power. The matter will, of course, have to be formally reported to the next ordinary open meeting of the Board, which is to be held on the 31st inst.; and it is probable that further discussion will ensue, seeing that the majority in favour of accepting the Electric Light Company's tender was only small.

Our readers will note that, in consequence of the publicity given to the question in these columns, and to the competition of the South Metropolitan Gas Company, the Electric Light Company have reduced their price for lighting by 33⅓ per cent.—that is to say, from 3d. to 2d. per unit. It naturally occurs to ask why, if the Company are now content with 2d., and not only content but are able to make a profit at that price, they should have in the first instance demanded not merely 3d., but 3½d.

But for the opposition, and we again say the publicity given to the matter in these notes, that price would have been accepted by the Guardians, and so the ratepayers of Lewisham would have been mulcted to the tune of 1½d. per unit over and above that which they are now asked to pay. Obviously that would have amounted to a very considerable increased demand upon the public pocket in the course of twelve months.

Question number two suggested is whether, after all, the Guardians are certain that, even now, the Electric Light Company have come down to the lowest possible figure. Is 2d. per unit for light the absolutely rock-bottom price? Is it not possible that the Board could get the Company down to (say) 1½d. per unit, or even 1¼d.?

We suggest that this is not beyond the bounds of possibility if the Guardians were to consider seriously the question of installing their own electric light making plant, as they have been shown they could as the result of their inspection of an installation at Balham, which is somewhat similar to that which they would require. In this way it would be possible to get the light at something under 1½d. per unit, even after writing-off the charges that an ordinary commercial man would necessarily set against such plant.

It seems that this would be a common-sense method of unravelling the tangle, and at the same time ensuring that the ratepayers get full value for their money. Then, too, the Guardians would not in any way be under an obligation to either of the two Companies supplying the rival forms of lighting.

Reverting for a moment to the question of the gas lighting of the Infirmary and Workhouse, it should be remembered that the installation of which certain complaints have been made in regard to the blackening of ceilings and the breakage of mantles, &c., is a system that is regarded by experts as being by no means up-to-date, and it is

one for which, we learn, the Gas Company are in no way responsible. It can very well be imagined that but for this the whole problem which is now awaiting solution would not have arisen.

The Guardians will no doubt understand that their duty is to the ratepayers as well as to the unfortunate poor who, from one cause or other, are obliged to seek the hospitality of the Workhouse or the Infirmary. The best possible system, at the lowest possible price commensurate with those considerations, is the system which they must instal.

TOTTENHAM GAS COMPANY AND ELECTRIC LIGHTING.

Conflict of Local Feeling.

There is considerable conflict of public opinion in the Wood Green neighbourhood in consequence of the Wood Green Urban District Council's decision to sell to the Tottenham Gas Company, its Provisional Order for the supply of electricity. [*ante*, pp. 163, 335, 615.]

What was regarded as an important meeting of the Wood Green Citizens' Association was held on March 13, with the object of considering a motion of censure upon the District Council, which was proposed by Councillor Holmes (himself a member of the Council, and the only one to oppose the scheme). The resolution he proposed was "that the Association disapproves of the attempt of the District Council to sell their Order to the Gas Company—being of opinion that it would be better for the district to have the competition of the North Metropolitan Electric Power Company introduced." Two years ago the Council decided not to work their Order; and he suggested that it should go, and someone else should come in and have a chance to supply. Then they had an application from Messrs. Edmonds, Denham, and Goyder, Limited (a local firm owning a large number of shops), for permission to lay a cable under a road to enable them to supply with electric light the local Music Hall and a number of new shops. When the Council granted this application, they took off a large slice of the monetary value of the Order, because they omitted to impose a provision about the powers reverting to the Council in the event of the Order being acted upon. At that time he thought the matter was all right; but he found out his mistake when the Hornsey Council applied for permission to supply electricity to a church and vicarage in the Wood Green district. In this case, however, the provision as to the permission being withdrawn was duly enforced; and the Council therefore reserved the full facilities of their Order. Then the Order was advertised; and the Council were informed that a private company were offering £500 for it. The name of the company was not divulged; and not regarding a great concern like the Tottenham and Edmonton Gas Company as a "private" company, he offered no objection to the Committee being empowered to act. He contended, however, that when it transpired that it was the Gas Company, a special meeting of the whole Council should have been called. The Power Company were abused because they did not come earlier into the field; but, as a matter of fact, they were the first in the field, and had submitted various schemes to the Council. The terms of one scheme for a supply in bulk were actually agreed upon by the old Council; but a newly constituted Council were elected, and they would not ratify the terms because they were opposed to municipal trading. What were the Company getting for the £500. They first bought over the Council's opposition—a very valuable asset; secondly, they had secured their co-operation against their competitors; and thirdly, in the event of the transfer taking place, they would have an absolute monopoly of the heat, power, and light of the town—an entire monopoly in an annual turnover of £50,000 for a payment of £500. It had been stated that Mr. Devonshire, of the Power Company, had belittled Wood Green by saying that it was not worth having; but as a business man, who wanted to make a good bargain, he would quite naturally speak like this. Mr. Holmes complained about the existing automatic gas lighting; stating that Wood Green was paying 1s. 9½d. per lamp more than the adjoining district of Southgate was paying, although they (Wood Green) had twice as many lamps.

The resolution having been seconded, Mr. J. Gilbert, a member of the Council, who supported the Gas Company, said as between the two Companies he had no confidence in the Power Company, who had adopted a dog-in-the-manger policy. When the Council first applied for their Order, they did all they could to oppose it. [Councillor Holmes: And so did the Gas Company.] It was not because of municipal trading that the new Council did not ratify the scheme; it was because the people of the district did not want it, and because the terms were not so good as the Council could have wished. The Order was offered to the Power Company; and he had in his pocket a copy of the reply from them stating that they would have nothing to do with it, and would pay nothing whatever for it. It was not until they knew negotiations were proceeding with the Gas Company that they definitely entered the field. At every stage, the terms of the Gas Company were better than those of the Power Company. As regards Wood Green paying more for street lighting than Southgate, that was an *ex parte* statement; and if all the facts were stated, the difference could be easily explained.

Mr. Denney proposed an amendment, that the Association approve the action of the Council in arranging to sell the Order to the Gas Company, considering that the interests of the consumers of electricity were more adequately safeguarded by the provisions of the Bill than the Order applied for by the Power Company. He remarked that the history of electric light in the district clearly showed that the Council had done all they could in the direction of dealing straightforwardly with the Power Company; and when they said they were not prepared to make any offer for the Order, the Council were justified in negotiating with the Gas Company.

Mr. Denham, a member of the firm above referred to, seconded the amendment. He said the Council had had a Provisional Order for ten years and failed to use it. Six or seven years ago, it was absolutely necessary in the interests of his firm, and to some extent in the interests of the district, that he should have electricity, and a plant was therefore put down. Two years ago, there came a development in the form of additional shops and a Music Hall, and the demand for electricity was so great that there was only one course open—to supply what were strictly their own shops with electric light. The Council were practically forced by the circumstances to let them go under the road. On Wednesday last, he accidentally ascertained that a Board of Trade inquiry was being held. He attended, and found that the Power Company were asking the Board of Trade to dispense with the consent of the Wood Green Council, which was necessary to their Order. Mr. Devonshire, of the Power Company, during his cross-examination, admitted that the total amount of the scheme scheduled in the Act of Parliament was only £8000—a ridiculously small sum; and they might depend upon it the Power Company wanted to come in, and never give, if they could possibly help it, a unit of electricity. They might supply the shops; but nobody else would ever get current. The Gas Company's schedule was for £30,000; and he could say that their schedule was much better as regards area, &c. It was elicited at the inquiry that there would have to be four profits for four dovetailing companies. Mr. Devonshire admitted that the Distribution Company was a special Company formed for the acquisition of the Order. The shares of the Distribution Company were practically held by the Power Company; the Power Company's shares, in their turn, being held by the Metropolitan Electric Tramways, and 86 per cent. of them were now owned by the London Suburban Traction Company. If Wood Green got into their hands, they were going to have a very rough passage. The Power Company's maximum price was 8d. per unit; and he did not think they would ever get current at 5d. There was nothing to fear from the absence of competition, because the Gas Company had to charge a uniform price for gas; and they would be obliged to regulate their price of electricity accordingly to keep their plant going. He believed the Gas Company's scheme was a perfectly sound one.

The discussion continued till between 11 and 12 p.m., when an adjournment was decided upon.

BURY AND DISTRICT WATER SUPPLY.

Proposed Exchange of Areas.

At the Bury Council Chamber, a few days ago, Mr. R. C. Maxwell held an inquiry on behalf of the Local Government Board in regard to applications made to them by the Corporation of Bacup and the Bury and District Joint Water Board for a Provisional Order to sanction the transfer of a portion of the borough of Rawtenstall, now in the Bacup water-supply area, to the Joint Board's area, and for a transfer of part of the Board's area in Rawtenstall to the Bacup area.

Mr. J. Entwistle, the Town Clerk of Bury, explained that the proposal would involve the transfer of certain mains which the Corporation had laid down; and one of the terms of the agreement entered into was that in respect of one part, which was the most populous, the Water Board should pay to the Corporation one-third of the gross revenue until a time specified in the agreement. He reviewed the history of the Bacup Water-Works, and pointed out that in the Corporation's Act there was a penalty clause under which they had to provide a supply of water in five years or be liable to a payment of £40 a week. They desired that this clause should not be applied to the new area. The supply was there, and they would be willing to give it. The Joint Board had a supply area of 80 square miles.

Mr. J. E. Diggle, Water Engineer to the Corporation, dealt with the engineering side of the application. He mentioned that at present the whole of one of the Bacup reservoirs, and also a part of the other, was in Rawtenstall. If the proposed exchange of areas was allowed, the two reservoirs would be entirely in the Bacup area. Replying to questions, he said the amount which would be paid by the Joint Board to Bacup under the one-third agreement would be about £95 a year. He thought this would cease at the end of twenty years, as by that time the requirements of the agreement would be met. In return, they were handing over to the Board a length of main and would also have on their hands the cost of filter-beds and a portion of the reservoirs which had been constructed mainly for the benefit of the particular part of Rawtenstall concerned.

Mr. J. Johnson, the Borough Engineer of Rawtenstall, urged that the proposed arrangement between Bury and Bacup would cause the inhabitants of one part of Rawtenstall to pay 10 per cent. for their water; whereas hitherto they had been supplied by Bacup at 7½ per cent. They, therefore, asked that if the area was transferred from Bacup to Bury, the liabilities should be transferred as well.

Other evidence having been given, the inquiry concluded.

Tottenham and Edmonton "B" Stock.—The recent issue, by the Tottenham and Edmonton Gas Company, of £60,000 of "B" stock resulted in tenders for £84,395; the average price realized for it being £116 10s. 8d. The prices received ranged from £115 to £119. Tenders at £116 and upwards were allotted in full.

Windsor Royal Gas Company.—At the recent half-yearly meeting of this Company, the Directors reported an increase of 9½ per cent. in the quantity of gas sold in the six months ended Dec. 31, compared with the corresponding period of 1911. The profit on the revenue account was £2402; and the balance available for distribution £8715. The full statutory dividend on all the shares was recommended.

Chesham Gas Company, Limited.—The profit of this Company for the past year, including the amount brought forward, was £1372; and at the annual general meeting on Monday last week the Directors recommended dividends at the rate of 5 per cent. on the preference and ordinary stocks. The payment of these would absorb £1050, and leave £322 to be carried forward. There was an increase of 9·7 per cent. in the sale of gas for the year. As from the 1st prox. the price will be reduced from 3s. 9d. to 3s. 8d. per 1000 cubic feet; and the Directors express the hope that this concession may lead to an increased use of gas for light, heat, and power. The report was adopted, and a vote of thanks passed to the Manager, Mr. G. Lane.

NOTES FROM SCOTLAND.

From Our Own Correspondents.

Saturday.

Edinburgh.—The Edinburgh and Leith Corporation Gas Commissioners' held their annual dinner on Thursday, under the chairmanship of the Lord Provost, when about 100 gentlemen sat down. In replying for the Imperial Forces, Colonel Henry O'Connor, of the Forth Royal Garrison Artillery, pointed out an interesting fact regarding a number of the commanding officers of the Territorial Corps in Edinburgh, which had special reference to the function they were attending in that Colonel Carmichael Peebles and himself were gas engineers. Colonel J. G. Wilson was formerly a Gas Commissioner of Edinburgh and Leith, and Major Ogilvie was an electric lighting engineer. The Lord Provost, in replying on behalf of the Corporation of Edinburgh, referred to the amalgamation between Leith and Edinburgh, and said that the proposal must come from Leith. Bailie Harvey (Leith) jocularly referred to this remark, and hoped that the people of Edinburgh would bear this point, made by the Lord Provost, in mind. The toast of "The Gas Commissioners" was proposed by Mr. James Gibson, the Chairman of the Edinburgh Parish Council, who reminded the company that this was the semi-jubilee of the Commission, and went on to refer to the early days of gas supply in Edinburgh and Leith, which had been in the hands of two private companies. He pointed out the benefits which had been accomplished by the purchasing of the two undertakings, whereby the community had been saved the fees of Directors and the dividends of shareholders. A further advantage was the ability to provide capital at such low rates of interest as to help considerably to develop the gas industry. The reply was in the hands of Bailie Lindsay (Leith), who is Convener of the Works Committee. He referred to the number of men employed, which is roughly 1000, and of the quantity of coal used daily during the busy season, which is about 1000 tons. In view of the fact that the darkness or lighting of the city of Edinburgh and the burgh of Leith was in the hollow of the Commissioners' hands, it would be seen that they had to administer a great trust—so great that the Corporation must see that only the best and most intelligent of their members should be elected to the Commission. He mentioned that they had installed over 4000 gas-cookers during the last twelve months, and many other cooking appliances and gas-fires, which had been to the evident satisfaction and comfort of a large number of the ratepayers.

The Lord Provost presided over a meeting of the Commissioners on Thursday, when the Treasurer reported an increase of £6541 in the collections over the corresponding period of last year. The consideration of the charges made at the last meeting by Bailie Pennell has been remitted to the Works Committee, who are to report on the evidence brought forward by him in support of his charges against certain of the foremen and workmen at the Granton Gas-Works. These men have requested that the Commissioners should hold such inquiry into the charges.

Arbroath.—The plans for the alterations and erection of the new retort-house for vertical retorts were before the Dean of Guild on Thursday, and were passed. The building will be 65 feet by 44 feet, and will have a total height of 75 feet.

Dunfermline.—It will be remembered that the Town Council and the District Committee have prepared rival water schemes for impounding the Devon and its tributaries. A conference took place on Thursday between representatives of these two bodies; and from the hopefulness of the city representatives it was thought that a compromise would be arrived at on the lines of amended proposals which they had submitted. However, the district members, who met afterwards by themselves, said that the inquiries regarding the two Provisional Orders will both proceed in Edinburgh on Tuesday, the 1st of April.

Glasgow.—The proposed huge scheme for including Lochs Voil and Doine in the area of the Glasgow water supply, which was referred to in last week's "JOURNAL" (p. 775), was brought before the Town Council on Thursday, when Bailie Maclure moved approval of the minutes of the Water Committee. He said that this was really the completion of the 1884 scheme, prepared by their late Engineer, Mr. Gale. He asked the Corporation to approve so that the scheme could be carried forward. Bailie Mason seconded. Mr. Battersby suggested that compulsory powers should be asked from Parliament for feuing rights as well as lands and wayleaves. Mr. W. F. Anderson asked for an approximate estimate of the cost of works and material. Bailie Maclure stated that this was not possible at the present time; but estimates would in due course be submitted. The general approval of the proposed extension of the supply was given.

Laurencekirk.—The annual general meeting of the Laurencekirk Lighting Society, Limited, was held in the Town Hall on Wednesday—Dr. Ironside, the Chairman, presiding. The report and balance-sheet were submitted and approved. After providing for depreciation, the profits amounted to £282 8s. 7d., and these fall to be appropriated as follows: 4 per cent. on the "A" shares, 10 per cent. of net profits to "A" shares reserve fund, 6 per cent. on the "B" shares, 4 per cent. on sums paid in anticipation of calls on poundage to members on gas accounts, &c, The depreciation fund now stands at £220; and the "A" share reserve fund at £91. The balance of net profit of the year, £48, is carried forward towards the building of retorts.

Stewarton.—The Provost of the Burgh headed a deputation from the Gas Company to the Girvan Gas-Works to inspect the new spiral-guided gasholder which had been recently put up there. The visit was made in view of the erection of a new holder at Stewarton, which the Company have in contemplation.

Improved Lighting in Belfast.—Great satisfaction is expressed in Belfast at the extension of improved lighting by lamps with triple inverted burners in two of the most important business thoroughfares—Victoria Street and Waring Street. These streets are approaches to the quays, and therefore much used for after-dark traffic. Other improvements are in contemplation.

CURRENT SALES OF GAS PRODUCTS.

LIVERPOOL, *March* 20.

Sulphate of Ammonia.

There is no new feature to comment upon in the market for this article, and during the past week quotations have remained at their recent level. The demand for home consumption has been moderate and that from direct buyers abroad rather poor; but the requirements of dealers for covering their March commitments before the holidays have proved enough to maintain prices. The nearest values at the close still are £14 per ton f.o.b. Hull, £14 1s. 3d. per ton f.o.b. Liverpool, and £14 2s. 6d. per ton f.o.b. Leith. The forward position is somewhat neglected so far as producers are concerned, and no actual business has transpired. Middlemen are reported to have been offering abroad on the basis of £13 15s. per ton at the ports, without attracting many buyers, even at this low price.

Nitrate of Soda.

The tone of this market continues steady, at 12s. and 12s. 1½d. per cwt. for ordinary and refined qualities respectively, on spot.

COAL TRADE REPORTS.

Northern Coal Trade.

The coal trade has been firm. The demand for steam coals is very strong; and as the supplies will be less for a week or so, the prices are good. Best Northumbrian steams are from 15s. 6d. to 15s. 9d. f.o.b.; second-class steams are about 14s.; and steam smalls from 10s. 6d. to 11s. 3d. For early delivery, the quantity offering is rather limited; but there is also the effect of large contracts in the market. The current prices of gas coals are well maintained. The quotations are from 15s. 6d. to 15s. 9d. per ton f o.b. for best Durhams; for seconds about 14s. 9d.; and for "Wear specials" 15s. 9d. The large contracts which have been previously named as in treaty for the Metropolitan Gas Companies may now be looked on as settled; and the prices are equal to about 12s. 10d. to 14s. per ton f.o.b., according to the class of coals. It will be seen that these prices are substantially lower than the current values; but they show an advance over those for the past year—an advance which is variously stated, but may be perhaps put as near 1s. 6d. per ton. How this may be influenced by the sea freights it is difficult to say. As often happens, the settlement of these large gas coal contracts brings others into the market; and thus there are now tenders asked for for several south country towns, two of which, including Plymouth, are for considerable quantities. There is also an inquiry for gas coals for Genoa and other Mediterranean ports, in single cargoes. Gas coke shows little alteration in the prices.

Scotch Coal Trade.

There has been no change in the coal trade throughout Scotland since the last report. On Thursday, on the Glasgow Coal Exchange, the prices quoted f.o.b. Glasgow were: Steam coal, 13s. 6d. to 14s.; splint, 15s. to 15s. 6d.; ell, 13s. 9d. to 14s. 6d.; trebles, 14s. to 14s. 6d.; doubles, 13s. 9d. to 14s. 3d.; and singles, 13s. 6d. to 14s.

Lad's Fall of Fifty Feet at the Doncaster Gas-Works.—A remarkable accident happened at the Doncaster Gas-Works last Tuesday. A lad named William Goodyear was engaged in painting the gasholder which has just been erected by Messrs. Clayton, Son, and Co., of Leeds. He was sitting on a chair attached to a pulley from the platform above, and was at a height of 50 feet when the rope broke, and he fell the entire distance. At 20 feet from the ground the chair struck the handrail; and to this circumstance the lad probably owes his life. The rail was bent by the force of the fall. Bouncing up, Goodyear came down on his side. In a dazed condition he was taken to the Royal Infirmary, where it was found that no bones were broken, and that there were no internal injuries, though the lad was suffering from shock.

Striking and Striking.—A case arising out of the recent gas-workers' strike was heard at the Liverpool City Police Court on Monday of last week, when three men were summoned for assault. The complainant, who was employed at the Garston Gas-Works, said that one night, when walking along the street, the defendants accosted him, and asked why he did not "come out, the same as the other men." He replied that he could not afford to do so, as he had a wife and children to keep. On this he was knocked down, kicked, and threatened with further violence. Subsequently, the man who had assaulted him called at his house, and expressed regret for what he had done. Complainant said he was willing that the matter should drop, provided the men promised not to threaten him again; and the summonses were withdrawn—the defendant who had committed the assault agreeing to pay the costs.

Wrexham Gas Company.—A dividend of 5 per cent. for the year has been declared by the Wrexham Gas Company; and the Directors have been authorized to increase the capital by the issue of £10,000 of ordinary stock, inclusive of premiums. At the meeting, the Chairman (Mr. J. Oswell Bury) said the past year had been marked by a steady growth of the Company's business The make of gas increased by more than 6 million cubic feet; and in spite of the high prices of coal and other materials, the Directors had not found it necessary to raise the charge for gas, which, he believed, was still the lowest in price and highest in quality in Wales. The free labour maintenance system continued to give great satisfaction to consumers; the number of burners attended to being 64,768, as compared with 34,886 the previous year. The co-partnership scheme was in a flourishing condition, and had been of mutual benefit to the Company and the employees. He referred to the excellent work of Mr. W. Heyward (Secretary), Mr. J. Braithwaite (Manager), Mr. Owen Evans (Assistant-Manager), and the remainder of the staff in every department. Mr. Braithwaite, he said, had passed through a very severe illness; but he never lost touch with the works, and was entitled to the highest praise for the way in which he had carried out a high-pressure main extension to Gresford and made improvements at the works.

Gas-Supply Area of the Scunthorpe District Council.

A Local Government Board inquiry has lately been held at Scunthorpe by Mr. T. C. Ekin, M.Inst.C.E., in regard to an application by the Scunthorpe Urban District Council for a Provisional Order to enable them to include within their limits of supply the township of Ashby, in the area of the Brigg Rural District Council. This would entail laying a trunk main along the roads of the Frodingham Urban District Council, whose area lies between Scunthorpe and Ashby. Frodingham objected to this, as they had decided to seek parliamentary powers for building gas-works of their own, and also to include Ashby in the limits of their supply. The scope of the inquiry also included the application of the Frodingham Council to purchase the mains of the Scunthorpe Council now laid in the Frodingham area, in accordance with the provisions of the Scunthorpe Gas and Water Act, 1899. It was frequently stated during the proceedings that the building of gas-works at Frodingham would be a waste of public money. When the proceedings finished, there was a provisional agreement among the interested parties that the district should be one for the purposes of gas supply, and that the works should be those of the Scunthorpe Council, to supply Scunthorpe, Cusby, Frodingham, Bumby, and Ashby, and to be under the management of a Joint Board; but no definite decision was come to.

Slaithwaite District Council and the Gas-Works.—Early in the present year, the Slaithwaite Urban District Council resolved that an expert gas engineer should be engaged in connection with a proposal which had been brought forward to approach the Gas Company with reference to the purchase of their undertaking by the Council. Negotiations between the parties had subsequently taken place; and the Company furnished the Council with all the information they required. At the last monthly meeting of the Council, however, the resolution was rescinded by a majority of one; and the Clerk was instructed to thank the Directors of the Company for the way the Council's representatives had been received, and for the information supplied.

Lighting of Dublin.—The question of providing gas lighting in certain Dublin city areas up to as early an hour in the morning (as in the case of electric arc lamps) has been under discussion, and Mr. W. T. Cosgrove has written to the Press to the effect that the Corporation last year directed the Lighting Committee to deal with the matter, which they did by estimating £10,829. This estimate, however, was reduced by the Finance Committee by £2500; and, in spite of protest, the Council accepted the reduced figure The councillor fears it will be difficult to have the amount restored, owing to the state of the finances. In the important suburban district of Drumconda, complaint is being made that the electric arc lights are of "very little use," and that "a great gloom" prevails while they are in use.

Gas Supply and Meter Testing in the City of London.

Professor Vivian B. Lewes, the Gas Examiner to the Corporation of London, reports that the supply to the City during the past year was satisfactory in all respects; the parliamentary requirements having been complied with in illuminating power, purity, and calorific value. The average results from all the testing-stations showed that practical uniformity had been attained in the quality of the gas made at its various works; "this being one of the most important essentials of a good supply." The tests were carried out daily at the three City stations. Mr. Hume, the Inspector of Gas-Meters, reports that the total number of meters tested was 102,585, and the fees paid £2992. Of these meters, 91,447 were correct and 11,138 were rejected. During the year, 55,100 prepayment meters, being 54·7 per cent. of the total, were submitted for testing. The popularity of the demand for this type of meter continued throughout the year. It is remarked that the office did not examine, nor did its seal ensure, the accuracy of the slot attachment; but as the actual charge to the consumer was based on the consumption recorded on the index of the meter, both parties were protected against any error of registration.

Public Lighting of Bromley.

Tenders for the public lighting were presented at last week's meeting of the Bromley Town Council, and referred to the Highways and Lighting Committee for consideration. The South Suburban Gas Company wrote offering to reduce the charge for lighting and maintaining ordinary lamps from £3 14s. to £3 3s. per lamp per annum; to convert 920 ordinary lamps with upright burners giving a light of 50 candles to inverted burners giving a light of 90 candles; to charge for 47 200-candle single burners £4 13s. 10d. per lamp per annum—44 to be converted so that each would have three inverted burners, giving a light of about 300 candles, and the remaining three to be converted with five inverted burners, giving a light of about 520 candles. All the proposed conversions would be made by the Company, at a total cost of about £1300; and they asked for a contract for a period of seven years, to give them time to recover some part of the outlay. A tender was also received from the Electric Light Company offering to light and maintain 1009 single 60 watt lights at £3 5s. 6d. each per annum, and 46 240 watt lamps at £6 10s. each per annum; the lamps to be lighted on a schedule of hours, and never to go below 90 per cent. of the proper candle power. They asked for a contract for a term of ten years, as a large capital expenditure would be involved in converting the lamps. They also undertook that the Council should benefit from any improvements in street lighting which might occur, on condition that, to meet any extra cost, the prices quoted should be subject to revision every third year of the contract.

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OIL CARBURETTED
WATER GAS PLANTS
ANY CAPACITY
MAKERS
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MANCHESTER
LONDON OFFICE: 165 GRESHAM HOUSE, OLD BROAD ST. E.C.

Devon Gas Association.

The seventh annual meeting of this Association was held last Wednesday in Exeter—Mr. F. T. Depree (the Chairman) presiding. The Chairman, in moving the adoption of the report, noticed last week (p. 782), congratulated the shareholders on a record year's working. He said there had been all-round increases on the expenditure side, due to additional works and the higher cost of materials; but, fortunately, the rise of 3s. per ton on coal had been satisfactorily met by improved income from residuals. Extensive developments had taken place at the Sturminster Newton Gas-Works, and the Association had been able to secure the Buckfastleigh gas undertaking, which also left room for very considerable development of business. There had been a 25 per cent. increase in the sale of gas. The Association was now on a substantial basis, with excellent prospects in future. In conclusion, he alluded to the coming National Gas Exhibition, and to the excellent work on behalf of gas companies which was being carried out by the British Commercial Gas Association. Mr. R. J. Rew, in seconding the motion, remarked that the Association had risen from a small beginning to a successful undertaking with good prospects. The total gas made had reached 15½ million cubic feet per annum; and considerably more than 1000 consumers were on the books. The thanks of the members were due to the Chairman for his generous assistance in connection with the Buckfastleigh undertaking; and he (Mr. Rew) felt sure that, being so near the Association's other works, this addition would materially strengthen their position. The report was adopted, and a dividend of 5 per cent. declared. At an extraordinary general meeting, it was resolved to increase the capital of the Association.

Maryborough (Queensland) Gas Company, Limited.—The profits of this Company for the half year ended Dec. 31, including the balance carried forward, were £1037; and the Directors recommended the payment of the usual dividend of 6 per cent. per annum, free of income-tax. This would amount to £794, and leave £243 to go to the next account.

Birkenhead Gas Undertaking.—Speaking at the annual dinner in connection with the Gas Engineer's Department of the Birkenhead Corporation, Mr. T. O. Paterson remarked that there was no corporation department that had increased so much as the one with which those assembled were associated. When he came to Birkenhead thirty-three years ago, the consumption of gas was only 240 million cubic feet, while the gas made in the current financial year would approach nearly 1000 millions. He only wished the wages of the men had increased at the same rate as the consumption. If they had done so, the lowest-rated man would now be receiving from £4 to £5 per week. Alderman J. H. M'Gaul, J.P., the Chairman of the Gas Committee, who presided, said the gas undertaking was the envy of more than one of the Corporation trading departments; and it was able to assist the ratepayers more than all the others put together.

A Cardiff Water Arbitration.

The result of a recent friendly arbitration between the Corporation and Mr. L. P. Nott, a contractor, was laid before the Cardiff Water Committee last Tuesday, when the Town Clerk presented a copy of the award of the Arbitrator (Mr. Walter Hunter). Mr. Nott had a contract in connection with the Llwyn-on Water-Works; and after it was entered into, the Corporation prohibited and restricted the use of explosives in connection with the work of excavation, with the result that the Contractor contended that he was entitled to compensation for the extra manual labour rendered necessary by such prohibition and restriction. A difference of opinion arose between the parties (1) as to the power of the Corporation, under the terms of the contract, to prohibit or restrict the use of explosives; (2) as to whether the Contractor was fairly and reasonably entitled, in the circumstances of the case and under the terms of the contract, to extra payment in respect of the prohibition and restriction; and (3) as to the amount of such payment, if any, and the manner in which it was to be arrived at. Mr. Hunter was appointed Arbitrator (his decision to be final); and having heard the evidence, he now directs the Corporation to pay to Mr. Nott the sum of £8240, in full discharge of all the matters referred to. The costs of the arbitration, including that of the award, are also to be paid by the Corporation; the Arbitrator's costs, which had been paid by the Contractor, amounting to £305. It transpired during the discussion that Mr. Nott's original claim amounted to £10,261, and that the restriction of the use of explosives was rendered necessary because of possible danger to the dam and other portions of the works. The Chairman (Alderman C. H. Bird) said the award was a great blow to the Corporation.

A Step towards Smoke Abatement.—The Manchester City Council have resolved that, as a step towards smoke abatement, the Town Hall Committee be instructed to consider and report to the Council upon the advisability of replacing coal-fires with gas-stoves and electric radiators wherever possible, in all rooms under their jurisdiction.

Proposed Coal Trade Sliding-Scale.—According to the "Financial News," an important conference between Northumberland miners and the coalowners was held at Newcastle on the 15th inst., for the purpose of considering the establishment of a sliding-scale for the regulation of wages. The owners proposed that when coal sells at 6s. 9d. per ton, or any figure below 6s. 10d., wages shall be 15 per cent. above the basis of 1879. When the price is above the figure named, advances or reductions in wages shall take place at the rate of 1 per cent. for each penny of change in the price, up to a maximum of 60 per cent. above the 1879 basis. The miners' counter proposal was that when the selling price is 7s. 2d. or less, the minimum shall be 30 per cent. above the basis of 1879, with 1 per cent. added for each penny rise in the selling price above 7s. 2d. No agreement was arrived at; but a Sub-Committee of members of each side was appointed to consider the proposals further.

The "Main" Boom.

The boom in our Cooker business furnished ample evidence of the appreciation in which our Cookers are held.

A Cooker of remarkable value is our "GOTHIC," as illustrated.

The "GOTHIC" is a highly finished packed and enamelled cooker of smart appearance, embodying the following features:—

Mounted on strong cast iron base; comparatively small cornice, enabling a cooker of good oven capacity to be fitted into a confined kitchen space; hinged and lifting cornice, removable burners, reversible grill.

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WORKS: Gothic Works, EDMONTON, N.; Gothic Ironworks, FALKIRK; and Gothic Works, BIRMINGHAM.
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Fatal Gas Explosion in Canada.—According to the correspondent of the "Daily Mail" at Winnipeg, six people, including two firemen, were killed, and damage to the amount of £50,000 was done, by an explosion of gas which wrecked the Western Canada Company's packing establishment at Medicine Hat, Assiniboia, last Thursday. Two of the people killed were Englishmen. The town in which the fatality occurred has come into prominence lately in connection with its large supply of natural gas.

Dartmouth Gas Company.—The shareholders of this Company met on Tuesday last to transact the business of the fifty-fifth annual meeting—the Chairman (Mr. R. W. Prideaux) presiding. The report for the year ended Dec. 31, 1912, showed receipts amounting to £5568—an increase of £318 on the previous year; while the expenditure was £4843, or £569 more than before. The balance carried to the profit and loss account was £725. After providing for debenture and other interest charges, the Directors recommended a dividend of 11s. per share on the ordinary shares, less income-tax. The number of prepayment meters and stoves in use was 900—an increase of 41. The report was adopted, and the dividend recommended declared.

Colliery Workings and Water Supply.—The effect upon water supply resulting from subsidences through colliery workings has more than once given rise to apprehensions in Nottinghamshire, where of late years there has been an enormous development in mining enterprise. The subject in relation to the Newthorpe district, which embraces an important mineral area, was brought under notice at the last meeting of the Basford Rural District Council, when a report was presented relating to the possible result of a subsidence in the neighbourhood. Asked whether there was any possibility of the water being drawn entirely away, or its volume seriously diminished, through the sinking of new pits, the Surveyor expressed his inability to answer the question off-hand; but he was asked to give special attention to the matter, which is causing alarm not only in this part of the country.

Lighting of Tottenham Court Road.—At the last meeting of the Holborn Borough Council, the Works Committee reported having received a deputation of occupiers of premises in Tottenham Court Road, who urged the desirability of still further improvements being made in the lighting of the thoroughfare, so as to bring it up to the standard of lighting in New Oxford Street. It was pointed out by the Committee that the lighting of the latter thoroughfare is provided by high-pressure gas, for which there are no facilities at present in Tottenham Court Road; and several members of the deputation replied that, individually, they would be prepared to take a supply of high-pressure gas for lighting their own premises if it were available. The Committee did not feel justified in giving the deputation any assurance that a high-pressure system would be installed, as this would entail considerable additional capital outlay; but instructions were given that the views of the deputation should be brought to the notice of the Contractors, in case they might feel disposed to undertake the laying of a high-pressure main at their own expense, when the desirability of revising the lighting system could be reconsidered.

Bexhill Water and Gas Company.—At the meeting of this Company on Thursday, the Directors will report a profit of £6508 available for distribution; and they recommend a dividend for the past half year at the rate of £6 10s. per cent. per annum on the original capital, and of £4 11s. per cent. per annum on the new capital. This, with provision for income-tax, will absorb £3742, and leave £2766 to be carried forward. The increase in the business of the Company has been satisfactory; the water revenue being 4½ per cent., and the gas revenue 12 per cent., above the figures for the corresponding period of 1911. The continued demand for gas renders it necessary to extend the retort-house; and in doing this the Directors intend to substitute regenerative retorts for the old settings.

Woodall-Duckham Retorts for Smethwick.—At a special meeting of the Smethwick Town Council last Tuesday, the Gas Committee reported that in consequence of the continued and substantial increase in the demand for gas they had for some time had under consideration the question of the installation of the second set of vertical retorts; and they had come to the conclusion that, in order to meet the requirements of the next winter, it will be necessary to proceed at once with the proposed extensions. They recommended the Council to accept the tender of the Woodall-Duckham Company for the construction and erection of eight beds, containing 32 vertical retorts, for £18,027. This amount is to include all necessary foundations and certain improvements and alterations to the No. 1 set of vertical retorts. The recommendation was approved.

Devonport Water Supply.—Mr. F. W. Lillicrap, the Water Engineer to the Devonport Corporation, read a paper on the water supply of the borough before a meeting of the Royal Sanitary Institute recently held at Plymouth. The Company which constructed the original works was formed in 1793, and the source of supply was the head waters of some of the rivers on Dartmoor. The Act of Parliament empowered them to make a leat 10 feet in breadth; the distance from the source to the town being 35 miles. In 1806, the Company displaced certain wooden trunk mains by iron pipes—the first of the kind introduced into this country; and from that date onwards alterations and additions had been made to the works, until Devonport now possessed one of the finest water supplies in the kingdom. The daily consumption averaged 3,027,000 gallons, or 39 gallons per head of the population. Of the original length of the leat, 17 miles were now in use; the remaining portion, where it ran through Yelverton and the suburbs of Devonport, having been abandoned and a pipe-line substituted for sanitary reasons. The Corporation acquired the works in 1906, and in 1907 obtained an Act of Parliament empowering them to spend £80,000 in improving them. The total storage was now 44 million gallons, which, in the author's opinion, would be sufficient for a number of years. There were eight filter-beds, which were capable of filtering 3,750,000 gallons of water per day. By the old Water Company's Act of 1876, they were required to provide a constant supply, at pressure, of filtered water. The Corporation recently completed an additional bed, so as to be able to fulfil this obligation.

ECONOMICAL CONTROL.

The Patent Thermostat supplied with THE CALEFACTOR controls the gas supply better than the greatest human care can do, and ensures that not a foot of gas is used beyond what is actually needed.

This makes the heating of water for domestic services a success. . .

JOHN WRIGHT & CO., ESSEX WORKS, BIRMINGHAM.

A correspondent has sent us the following remarks, which appeared in the "Observer" on the 16th inst., under the head of "City Comments." He considers them specially interesting, coming as they do from a presumably unbiassed source. "We hope that most electric lighting directors have not the enthusiasm of the Chairman of the Brompton and Kensington. He is a 'whole-hogger' in the matter of electric cooking, and the Company is apparently committed to an expensive campaign in its favour. We are afraid that, both as regards cooking and heating, we regard developments as highly speculative and expensive. If much money is sunk in appliances at this stage, which can only be looked upon as very experimental, having regard to known difficulties of working and deficiencies, it is probable much money will be lost. If electric lighting companies as a whole chose to subscribe to an experimental fund, that is one thing. This development seems to our thinking rather risky."

Mr. A. Russell Thomas, a Solicitor, and a former Mayor of Neath, was discovered dead in bed on Monday morning last week, with gas escaping from a stove in the room. The medical evidence showed that the cause of death was asphyxiation, due to coal gas poisoning—the docter stating that in the case of deceased only a small amount of gas would be required to produce fatal results, as he had already been under treatment three times for acute heart failure. The Coroner said that possibly Mr. Thomas had turned on the gas to warm the room, forgotten to light it, and returned to bed. The Jury returned a verdict in accordance with the medical evidence, and expressed the deepest sympathy with the bereaved family.

GAS COMPANIES' STOCK AND SHARE LIST.

As usual, business on the Stock Exchange for the four loose days preceding Good Friday was almost a negligible quantity. In fact, as soon as the fortnightly settlement had been completed the week before, the House settled down into a condition of indolence until the Easter holiday should be past and gone. And there was nothing going on in the world that could be expected to liven it up; for the old perturbing political and international factors were still at work, and the eventual disentanglement seemed as difficult to forecast as ever. Markets in general therefore went heavily; but an agreeable exception to this was conspicuous in Home Government issues, and Consols were cheerful and buoyant. The opening was not favourable, owing to the bad points above referred to; and a renewal of Continental sales and caution in avoiding commitments were the order of the day. Gilt-edged were fair, and Consols steady; but the rest were dull and weak. On Tuesday, business grew quieter and quieter. Home Rails were languishing with lower prices, and American very dull. Government issues were firm, however, and Consols rose ¼. Wednesday had a similar gratifying feature in the firmness of Government issues, and Consols gained another ⅛. But this could not help Rails, which kept on drooping; and American and Foreign were dull. Thursday was the last working day of the week—business slowly dragging on to a full stop. Most markets were too quiet to be able even to show weakness. But Government issues could still show their strength; and Consols advanced ⅛, closing at 73⅝ to 73⅞—a rise of ⅜ in the week. In the Money Market, the position ruled very firm with a nice demand, and discount was a shade harder. Business in the Gas Market was quiet enough, but it had one or two points of interest. The general tendency was steadiness—if evidenced by the fact that in the London Market only one issue had any variation in its quotation. Also, a fair slice of the business ran in one or two not usually pre-eminent for activity. In Gaslight and Coke, the ordinary was only moderately dealt in, and prices were practically unchanged—ranging from 101½ to 102¼. There was more activity in the secured issues. The maximum realized 81, the preference from 96 to 98, and the debenture 72½ to 74—a fall of 2. South Metropolitan was dealt in at 112 to 113; and the debenture fetched 74½. Nothing was marked in Commercials. Among the Suburban and Provincial group, Alliance and Dublin changed hands at 77 and 78, British at 45⅝ and 45¾, and South Suburban at 118¼. On the local Exchange, Sheffield "C" marked 225 *ex div.*—a fall of 1. In the Continental companies, Imperial marked from 172 to 173¾, Union 84¼ and 85, and European from 18⅛ to 18⅜. Among the undertakings of the remoter world, Bombay fetched 6⅞, Cape Town debenture 78½, Primitiva 6 13/16 and 6 15/16, and ditto preference from 4⅞ to 5 1/16.

Issue.	Share.	When ex-Dividend.	Dividend or Dividend & Bonus.	NAME.	Closing Prices.	Rise or Fall in Wk.	Yield upon Investment.	Issue.	Share.	When ex-Dividend.	Dividend or Dividend & Bonus.	NAME.	Closing Prices.	Rise or Fall in Wk.	Yield upon Investment.
£			p.c.				£ s. d.	£			p.c.				£ s. d.
1,551,868	Stk.	Oct. 11	5	Alliance & Dublin Ord.	75–80	..	6 5 0	561,000	Stk.	Feb. 27	10	Liverpool United A .	218–220	..	4 10 11
374,000	,,	Jan. 16	4	Do. 4 p.c. Deb.	83–86	..	4 13 0	718,100	,,	,,	7	Do. B .	155½–157½	..	4 8 11
280,000	5	Oct. 11	7½	Bombay, Ltd. . . .	6½–7	..	5 7 2	806,083	,,	Dec. 20	4	Do. Deb. Stk.	98–100	..	4 0 0
50,000	10	Feb. 27	15	Bourne-) 10 p.c. . .	28½–29½	..	5 1 8	63,480	Stk.	Jan. 16	3	Maidstone 3 p.c. Deb. .	68–70	..	4 5 9
332,000	10		7	mouth Gas) B 7 p.c. .	15⅞–16½	..	4 6 8	75,000	5	Nov. 28	6	Malta & Mediterranean	4¼–4¾	..	6 6 4
75,000	10	,,	6	and Water) Pref. 6 p.c.	13½–14½	..	4 4 3	250,000	100	Oct. 1	4½	Met. of) 4½ p.c.Deb. Melbourne)	99–101	..	4 9 1
880,000	Stk.	Feb. 27	14	Brentford Consolidated	260–265	..	5 5 8								
330,000	,,	,,	11	Do. New . . .	200–205	..	5 7 4	541,920	20	Oct. 30	3½	Monte Video, Ltd. . .	12⅜–13¼	..	5 5 8
50,000	,,	,,	5	Do. 5 p.c. Pref. .	113–115	..	4 6 11	1,775,892	Stk.	Feb. 27	4½	Newc'tle&G'tesh'd Con.	100⅝–101¼	..	4 9 9
206,250	,,	Dec. 12	4	Do. 4 p.c. Deb. .	94–96	..	4 3 4	529,705	Stk.	Dec. 30	3½	Do 3½ p.c. Deb.	85–86	..	4 1 5
217,380	Stk.	Feb. 27	11	Brighton & Hove Orig.	205–210	..	5 4 9	55,940	10	Feb. 27	7/7/0	North Middlesex 7 p.c.	13–14	..	5 4 7
244,200	,,	,,	8	Do. A Ord. Stk. .	150–153	..	5 4 7	300,000	Stk.	Nov. 28	8	Oriental, Ltd. . . .	125–130	..	6 3 1
530,000	20	Sept. 27	12½	British	45½–46¼	..	5 8 1	60,000	5	Sept. 27	10	Ottoman, Ltd. . . .	8½–8⅝	..	5 14 3
120,000	Stk.	Dec. 30	4	Do. 4 p.c. Deb. Stk.	93–91	..	4 7 11	60,000	50	Feb. 27	13	Portsea, Island B . .	125–128	..	5 1 7
245,771	Stk.	,,	4	Buenos Ayres 4 p.c. Deb.	92–94	..	4 5 1	100,000	50	,,	12	Do. C . .	122–125	..	4 16 0
100,000	10	—	—	Cape Town & Dis., Ltd.	2–3	..	—	249,980	5	Oct. 11	8	Primitiva Ord. . . .	6 1/16–7	..	5 14 4
100,000	10	—	—	Do. 4½ p.c. Pref. .	4–5	..	—	499,960	5	Dec. 30	5	,, 5 p.c. Pref. .	4 7/16–5⅛	..	4 17 7
100,000	Stk.	Dec. 30	4½	Do. 4½ p.c. Deb. Stk.	78–83	..	5 8 5	521,600	100	Dec. 2	4	,, 4 p.c. Deb. .	96–98	..	4 1 8
157,150	Stk.	Feb. 13	5	Chester 5 p.c. Ord. . .	107½–109½	..	4 11 4	846,198	Stk.	Dec. 30	4	River Plate 4 p.c. Deb.	92–94	..	4 5 1
1,513,280	Stk.	Feb. 27	5/9/4	Commercial 4 p.c. Stk.	104–106	..	5 3 1	275,000	5	Apl. 12	12	San Paulo, Ltd. . . .	13–14	..	4 5 9
560,000	,,	,,	5½	Do. 3½ p.c. do. .	101–103	..	5 3 6	150,000	10	Sept. 27	6	Do. 6 p.c. Pref. .	11½–12	..	5 0 0
475,000	,,	Dec. 12	3	Do. 3 p.c. Deb. Stk.	71–73	..	4 2 2	125,000	50	Jan. 2	5	Do. 5 p.c. Deb. .	49–51	..	4 18 0
800,000	Stk.	,,	4	Continental Union, Ltd.	84–87	..	4 12 0	135,000	Stk.	Mar. 13	10	Sheffield A	226–228*	–1	4 7 9
200,000	,,	,,	7	Do. 7 p.c. Pref.	130–132	..	5 6 1	209,984	,,	,,	10	Do. B	224–226*	–1	4 8 6
492,270	Stk.	—	5⅞	Derby Con. Stk. . . .	124–125	..	4 12 0	523,500	,,	,,	10	Do. C	224–226*	–1	4 8 6
55,000	,,	—	4	Do. Deb. Stk. .	103–105	..	3 16 2	90,000	10	Sept. 27	7½	South African . . .	10–11	..	6 16 4
1,002,180	10	Jan. 16	10	European, Ltd. . . .	18–19	..	5 5 3	6,429,895	Stk.	Feb. 13	5/9/4	South Met., 4 p.c. Ord.	112–114	..	4 15 10
16,415,840	Stk.	Feb. 13	1/17/4	Gas-) 4 p.c. Ord. . .	101–103	..	4 14 7	1,895,445	,,	Jan. 16	3	Do. 3 p.c. Deb.	74–77	..	3 17 11
2,600,000	,,	,,	3½	light) 3½ p.c. max. .	80–83	..	4 4 4	209,820	Stk.	Feb. 27	8½	South Shields Con. Stk.	160–162	..	5 4 11
4,062,235	,,	,,	4	and) 4 p.c. Con. Pref.	96–99	..	4 0 10	952,795	Stk.	Feb. 27	6	S'th Suburb'n Ord. 5 p.c.	117–119	..	5 0 10
4,674,850	,,	Dec. 12	3	Coke) 3 p.c. Con. Deb.	72–75	–2	4 0 0	60,000	,,	,,	5	Do. 5 p.c. Pref. .	115–117	..	4 5 6
258,740	Stk.	Mar. 13	5	Hastings & St. L. 3½ p.c.	89–91*	..	5 9 11	117,058	,,	Dec. 30	5	Do. 5 p.c. Deb. Stk.	117–119	..	4 4 0
82,500	,,	,,	6½	Do. do. 5 p.c.	—	..	—	594,740	Stk.	Nov. 14	5	Southampton Ord. . .	102–105	..	4 15 3
70,000	10	Oct. 11	11	Hongkong & China, Ltd.	16½–16¾	..	6 11 4	120,000	Stk.	Feb. 13	7½	Tottenham) A 5 p.c. .	139–142	..	5 2 1
131,000	Stk.	Mar. 13	7⅝	Ilford A and C . . .	154–155*	..	4 18 4	483,940	,,	,,	5⅝	and) B 3½ p.c. .	114–116	..	4 19 2
65,780	,,	,,	6⅛	Do. B	120–122*	..	5 0 5	149,470	,,	Dec. 30	4	Edmonton) 4 p.c. Deb.	92–94	..	4 5 1
65,500	,,	Dec. 30	4	Do. 4 p.c. Deb. . .	89–91	..	4 7 11	182,380	10	,,	5	Tuscan, Ltd.	5–6	..	8 6 8
4,940,000	Stk.	Nov. 14	9	Imperial Continental .	171–176	..	5 2 3	149,900	10	Jan. 2	5	Do. 5 p.c. Deb. Red.	96–98	..	5 2 0
1,235,000	Stk.	Feb. 13	3½	Do. 3½ p.c. Deb. Red.	85–87	..	4 0 6	236,476	Stk.	Feb. 27	5	Tynemouth, 5 p.c. max.	115–116	..	4 6 2
200,242	Stk.	Mar. 13	6	Lea Bridge Ord. 5 p.c. .	120–123*	..	4 17 7	255,636	Stk.	Mar. 13	6⅞	Wands-) B 3½ p.c. .	137–140*	..	4 18 2
								85,766	,,	Dec. 30	3	worth) 3 p.c. Deb. Stk.	68–70	..	4 5 9

Prices Marked * are "Ex. Div."

WANTED, FOR SALE, CONTRACTS, &c., ADVERTISEMENTS IN THIS WEEK'S "JOURNAL."

Appointments, &c., Vacant.

ENGINEER AND MANAGER. York Gas Company. Applications by March 31.
FOREMAN (Hot-Water Installations). No. 5710.
GENERAL MANAGER. Chesterfield Gas and Water Board. Applications by April 16.
MECHANICAL DRAUGHTSMAN. No. 5713.

Appointments, &c., Wanted.

LONDON GAS OR MANUFACTURER'S OFFICE. No. 5714.
SHOW ROOM OR DISTRIBUTION DEPARTMENT. No. 5712.

Plant, &c. (Second-Hand), For Sale.

WASHER-SCRUBBER. No. 5711.

Plant, &c. (Second-Hand), Wanted.

EXHAUSTER AND ENGINE. No. 5704.

Patent Licences, &c.

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Stocks and Shares.

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BRIGHTON AND HOVE GAS COMPANY. London Mart. April 1.
BROKEN HILL WATER SUPPLY. London Mart. April 1.
DORKING GAS COMPANY. London Mart. April 15.
GRAVESEND AND MILTON WATER COMPANY. London Mart. April 1.
HERNE BAY GAS COMPANY. London Mart. April 1.
HORNSEY GAS COMPANY. London Mart. April 1.
HUNGERFORD GAS COMPANY. London Mart. April 1.
NORTH MIDDLESEX GAS COMPANY. London Mart. April 1.
ST. MARGARETS GAS COMPANY. London Mart. April 15.
SOUTHAMPTON GAS COMPANY. By Tender. April 15.
UXBRIDGE GAS COMPANY. London Mart. April 15.
WYVENHOE GAS COMPANY. London Mart. April 15.

TENDERS FOR

Coal.

MORECAMBE GAS DEPARTMENT. Tenders by April 5.

Coke.

WANDSWORTH, &c., GAS COMPANY. Tenders by March 28.

Pipes, &c.

RHONDDA GAS AND WATER DEPARTMENT. Tenders by April 3.

Retort Installation, &c.

CLEVEDON GAS COMPANY. Applications by April 9.

Tar.

ERITH URBAN DISTRICT COUNCIL. Tenders by April 9.

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